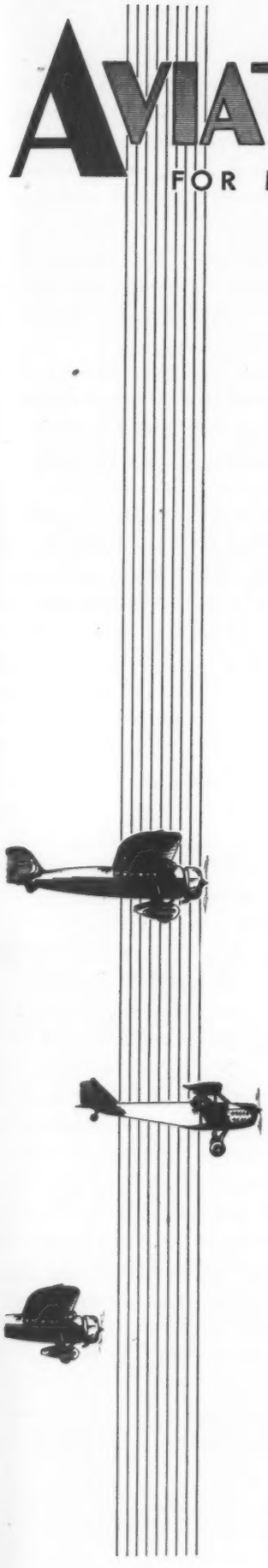
AVIATION
FOR MARCH, 1933



A salutation to the new President

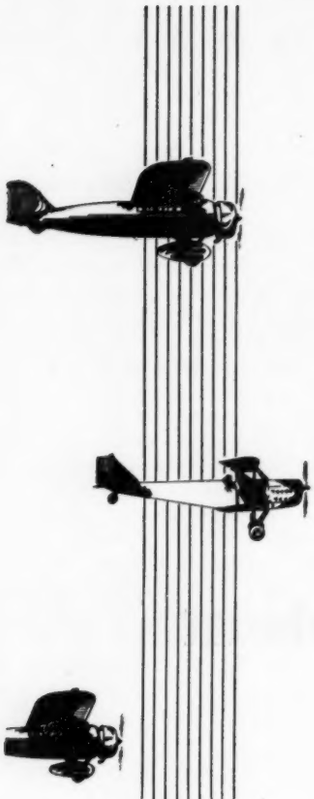
Hon. FRANKLIN D. ROOSEVELT,
Washington, D. C.

Dear Mr. President:

ON JULY 2, 1932, you boarded a transport airplane at Albany and flew to Chicago to address the convention that had just nominated you for the presidency. You enter the White House as the first American president ever to have flown either prior to or during his term of office. We need not extol the utility of aviation to you. You know. You have seen for yourself.

This issue of AVIATION appears just as you are about to become the Chief Executive of the American people. Among the innumerable problems that will surround you to clamor for consideration will be the development of a rational and well-balanced aeronautical policy for your administration. Without a definite policy, definitely established and given some measure of continuity, there can be neither efficiency nor economy. An intelligent policy must be guided, and in fact very largely controlled, by the facts of the present situation and by the lessons of experience. It has been our effort, in the pages that immediately follow the conclusion of this letter, to assemble the most important of the material that must be taken into account in deciding upon the future course of the Federal Government in its relations to aviation. The resultant collection of data, part of it wholly new, part of it already widely known, is very respectfully submitted to you, to your administration, and to the membership of the incoming Congress.

It is a rather striking collection. It constitutes a record of spectacular accomplishment which may well be a source of great pride to all those who have been concerned in making it, and a stimulant to them or to their successors to carry on without loss of ground or loss of momentum. In three years of depression of unprecedented intensity, the passenger traffic upon American airlines has tripled:



the mileage flown in air transport has doubled; the use of the air mail has increased by 20 per cent, while the revenue of the Post Office department from all other sources has fallen off by 17 per cent. American airplanes and engines have taken a place of steadily growing importance upon the airways of the world, until today there is scarcely a country in the world where the sky does not echo to the exhaust of American engines and the beat of American propellers, or where the sun does not cast upon the ground the shadow of American wings. The number of licensed pilots is almost twice what it was three years ago, and new pilots continue to qualify at the rate of almost 100 a week.

IT IS a glowing picture that we present. The tints that that picture will assume in future depend more upon the Federal Government than upon any other one thing. Let us be specific. The future depends pre-eminently upon the policy of your administration.

Your trip from Albany to Chicago became possible because of the existence of the air mail service, of the airways prepared by the Department of Commerce, and of the great numbers of airports built and operated, in most cases, by municipalities. The continued availability of a complete, reliable, safe, and efficient national air transportation system for the service of some millions of your fellow citizens depends upon the maintenance of the organization that has been created. Within a few days prior to the composition of this letter there has been serious discussion either of the actual abolition of the air-mail service or of a reduction in the scope of that service which would hobble and hamstring it. In looking upon the record as we have presented it between these covers, I am sure that you and your associates will agree that it is almost incredible that anything of the sort should even have been discussed. Nevertheless it is true.

Suggestions that economies might be effected by cutting the amount of service in half, or by turning it back onto a few experimental routes, are demonstrably unsound. This country is too large for a small scale transportation system to have any meaning even as an experiment. We must carry on upon a national scale if we are to carry on at all. There is no more economy in trying to run half an air-transport system than in trying to run a six-cylinder automobile engine with only four spark plugs. There is no economy in letting air transport pass into a state of suspended animation, for the life blood of air transport is in the organizations that have been created. If we destroy and scatter those organizations, we cannot look forward to picking up the work again where it was left off. We shall have to rebuild almost from the beginning. The only true economy will be found in promoting a continuance of that steady progress toward complete self-support which has marked the record of the last four years. In 1929 the *net* cost of air mail service to the Post Office department was approximately 80 cents per mile flown. At the present time it is less than half that. Let development go forward, with such changes of course and revisions of policy as accumulating experience may from time to time indicate to you and your Postmaster General to be desirable, and within a very few years the net cost will be down to zero and the service will be returning the government a profit.

In the meantime the air transport system, which must temporarily lean upon the air mail for support, is a national asset and a fruitful source of employment.

American air transport employs over 6,000 people directly and from 3,000 to 6,000 more indirectly. If the whole air mail appropriation were considered as a device for creating employment, the relation between the amount of money spent and the number of jobs called into being would be much more favorable than on many approved public-works projects.

IT IS NOT only air transportation that is involved in the formulation of an aeronautical policy. There is also the question of military aviation. That too is a critical problem.

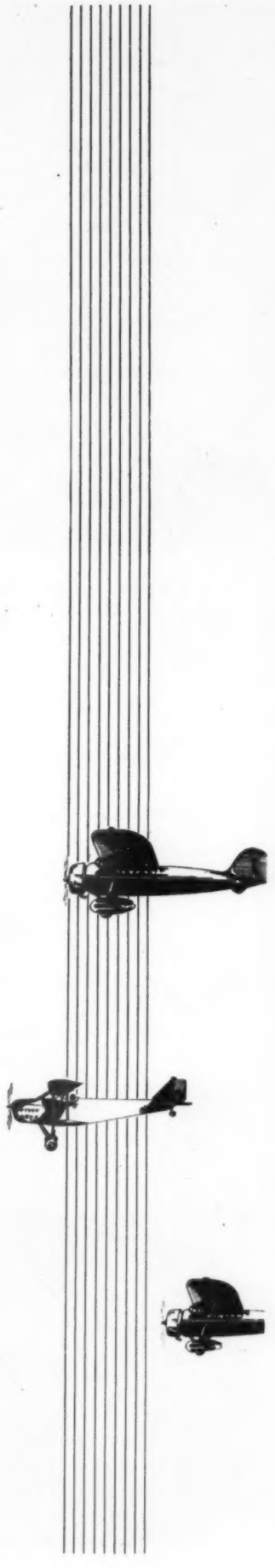
The American people are pacific by temperament, and far more devoted to conciliation than to conflict, but we cannot overlook the meaning of a deeply disturbed world situation. Three undeclared wars are now in actual progress. Others appear in the making. While other countries maintain their appropriations for military aviation, we have cut down on ours. We have cut down both absolutely and relatively, reducing the proportion of our total national defense appropriations going into the operations of the air arms in complete defiance of the teaching of all recent experience and of the warnings of practically all sober students of military affairs that the relative importance of the place of aviation in military activities is constantly growing. The available amount for military and naval aviation during the first fifteen months of your own administration, taking the appropriation bills as they now stand, will be less than in any similar period for more than five years past.

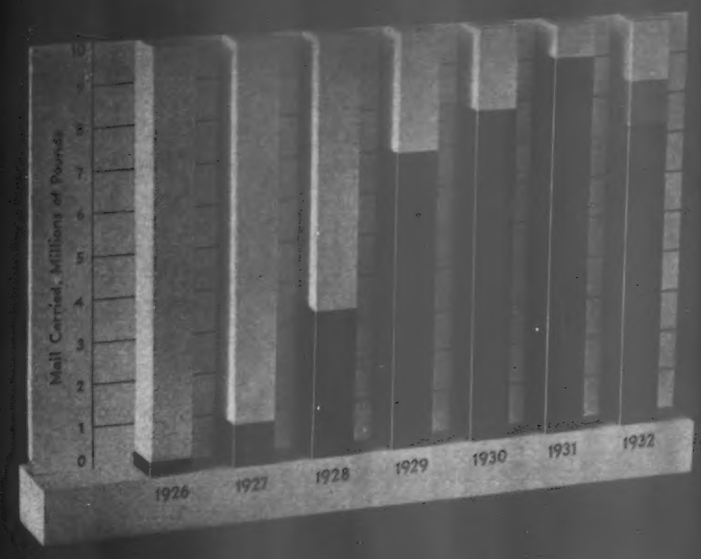
Here again, as in the case of the appropriation for air mail, it is not a transitory problem that confronts us. It is not a case of being able to economize now and make up the lost ground later without lost motion. The maintenance of an efficient aeronautical industry, capable of satisfying a military demand when it exists, requires above all things that a nucleus of personnel be held together to carry on technical developments. At the present time, due to the effects of the depression upon potential private purchasers of aircraft, the commercial market is inadequate for the support even of skeleton organizations. The military side must carry the load for the time being if we are to keep aviation going forward. If military appropriations for aeronautical purposes continue to be reduced we shall find in due course that we have annihilated the only sources of supply upon which we can depend in time of need. The aircraft industry can establish its right to be considered as a vital national asset.

AS WE LOOK to the future, we consider ourselves extraordinarily happy in seeing as Chief Executive of the nation a man who was intimately associated with the earliest infancy of naval aviation and with its development to adult estate. We lay the record of American aviation, and American aviation's case, before you. We feel that the record is good. We believe that the case is a strong one, and we know that it represents a national interest of immense importance. We leave it in your hands.

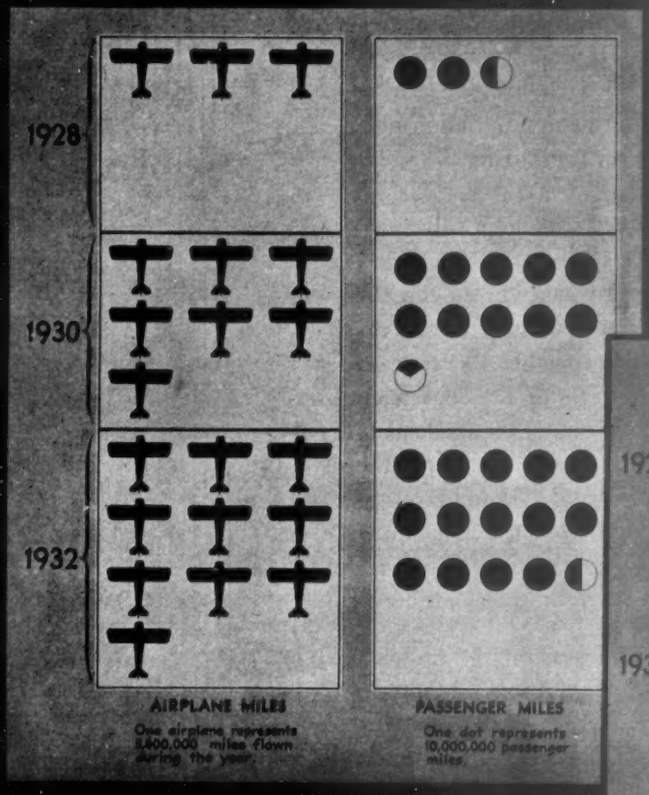
Very respectfully yours,

The Editors of AVIATION

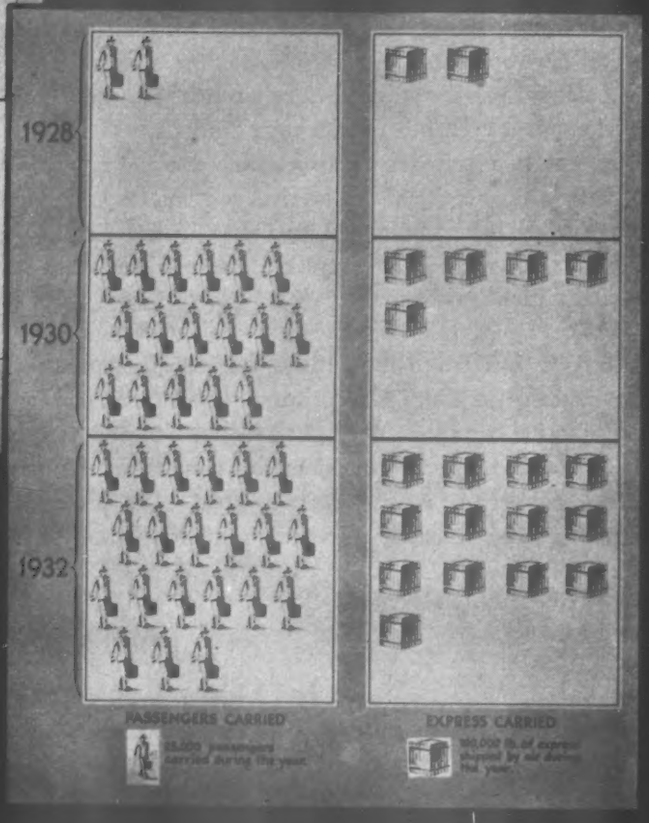




Air mail poundage. The tinted section of the 1932 bar shows the approximate poundage figure that would have been recorded in that year if it had not been for a change of allocation of certain transcontinental mail which resulted in a change of accounting methods. Taking that into account, the real decrease from 1931 to 1932 was 7 per cent, entirely due to the increase in postal rates in July. Up to that time, all comparable air mail figures were consistently running ahead of levels for the previous year, as they have been ever since 1927.



Transport mileage and passenger mileage. American airlines flew 18,000,000 miles in 1932, and their passenger traffic totaled 145,000,000 passenger-miles. The latter figure, equivalent to moving the entire population of Schenectady or Little Rock on a round trip from their home towns to Chicago and back, is increased 21 per cent over the record of the previous year.



Airline passengers and express. The American people are really beginning to flock to air transport, at which they once looked askance except for a possible occasional flight ventured in Europe. In 1932, 534,000 of them flew on American lines. Air express business grows even more rapidly. Its volume has tripled in two years, and last year it reached 1,324,000 lb.

Air transport gains favor

Passenger and express traffic make new records

AIR TRANSPORT has won fame as a depression-proof industry. While practically everything else in the world has been going down, air transport has been going up. While branches of business which have always prided themselves on their independence have been clamoring for government support, the reliance of air transport upon the air mail has been gradually diminishing, and a state of complete economic self-sufficiency with commercial traffic alone has been steadily approached.

A year ago it looked as though the depression had at last struck home in transport flying. Though the miles flown in 1931 were up 29 per cent from the 1930 figure, the passenger-miles had increased only 16 per cent. The average number of passengers carried in each transport airplane during the year had actually decreased.

No depression here

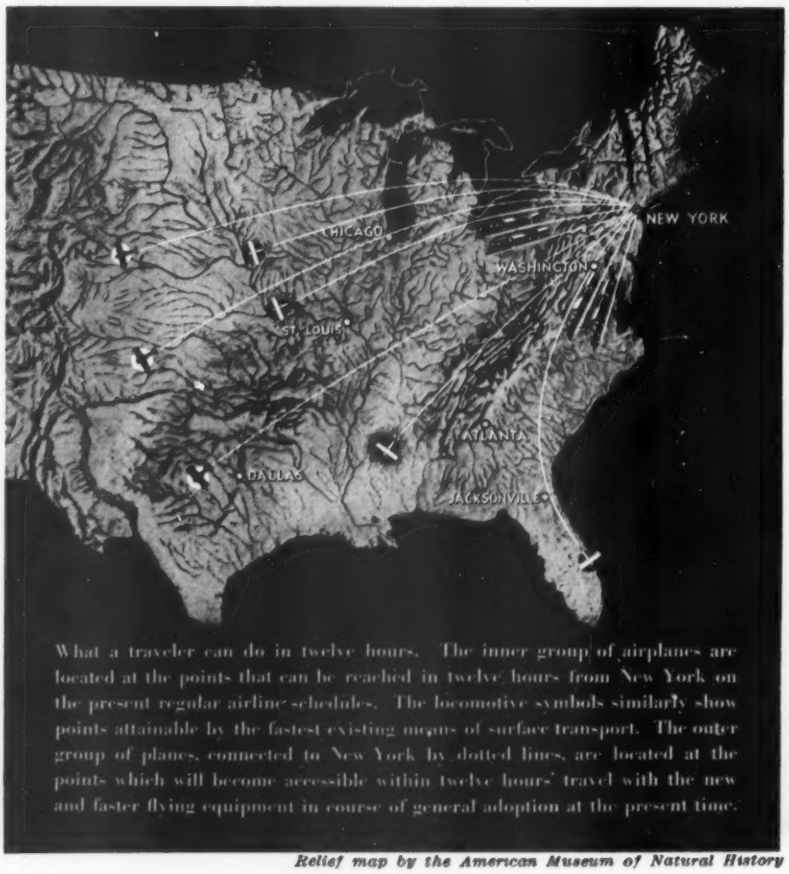
The year just ended, however, turned the curve back to a resumption of its previous determined climb. Though the mileage flown in 1932 was very little larger than that of 1931, the passenger traffic as indicated by passenger mileage was increased by almost one quarter. Excluding the mileage flown by airplanes on which no passengers were accommodated, an average of better than four passengers were carried upon every scheduled transport trip during the year. The commercial load factors of the airplanes, or proportion of the available seats occupied by paying guests, ran higher than ever before.

Though the passenger business steadily grows in magnitude and in importance, air mail is still the necessary nucleus of transport flying. A casual examination of the air mail records seems to leave 1932 with one unhappy blot upon its history. At first sight, if the figures be taken as they are regularly reported, and if there be no examination of what lies below the surface, the air mail seems to have decreased 20 per cent from the previous year. Such a decrease, *if it had happened,* would be easy enough to understand. It would simply be in parallel with the general decline of business activities and the general decline of postal receipts. *But it did not happen.*

On the contrary, if the figures for 1932 be examined on a basis really comparable with those for 1931, the air mail service gained and did not decline. They show a gain of about 8 per cent in public use of the air mail service for the months in which any true comparison between 1931 and 1932 can be established. A 60 per cent increase in postage rates at the beginning of July naturally produced a sharp drop in the amount of mail sent, and that showed itself in the totals for the year.

Even before July, however, totals of poundage as commonly reported had become misleading. During 1931 the transcontinental mail between New York and Los Angeles was flown over three separate routes, operated under as many separate contracts, and it was counted three times in making up the reported totals. Beginning in 1932, such mail has been routed straight through and counted only once. As indicated by a grey-tinted section of the right-hand bar on the chart at the top of the opposite page, that change in accounting method made a difference of approximately 1,200,000 lb. in the apparent amount of mail. The 20 per cent loss which the air mail is frequently stated to have undergone in 1932 is therefore purely a fictitious one. It is a bookkeeping item.

Not even the most superficial examination, on the other hand, can fail to show the progress that has been



What a traveler can do in twelve hours. The inner group of airplanes are located at the points that can be reached in twelve hours from New York on the present regular airline schedules. The locomotive symbols similarly show points attainable by the fastest existing means of surface transport. The outer group of planes, connected to New York by dotted lines, are located at the points which will become accessible within twelve hours' travel with the new and faster flying equipment in course of general adoption at the present time.

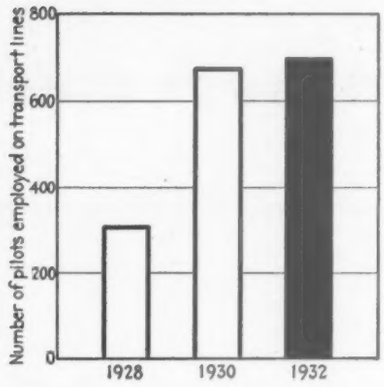
Relief map by the American Museum of Natural History

made in the air express service. If air express can continue its present curve of growth it will exceed air mail in volume within another three or four years.

Higher and higher speeds

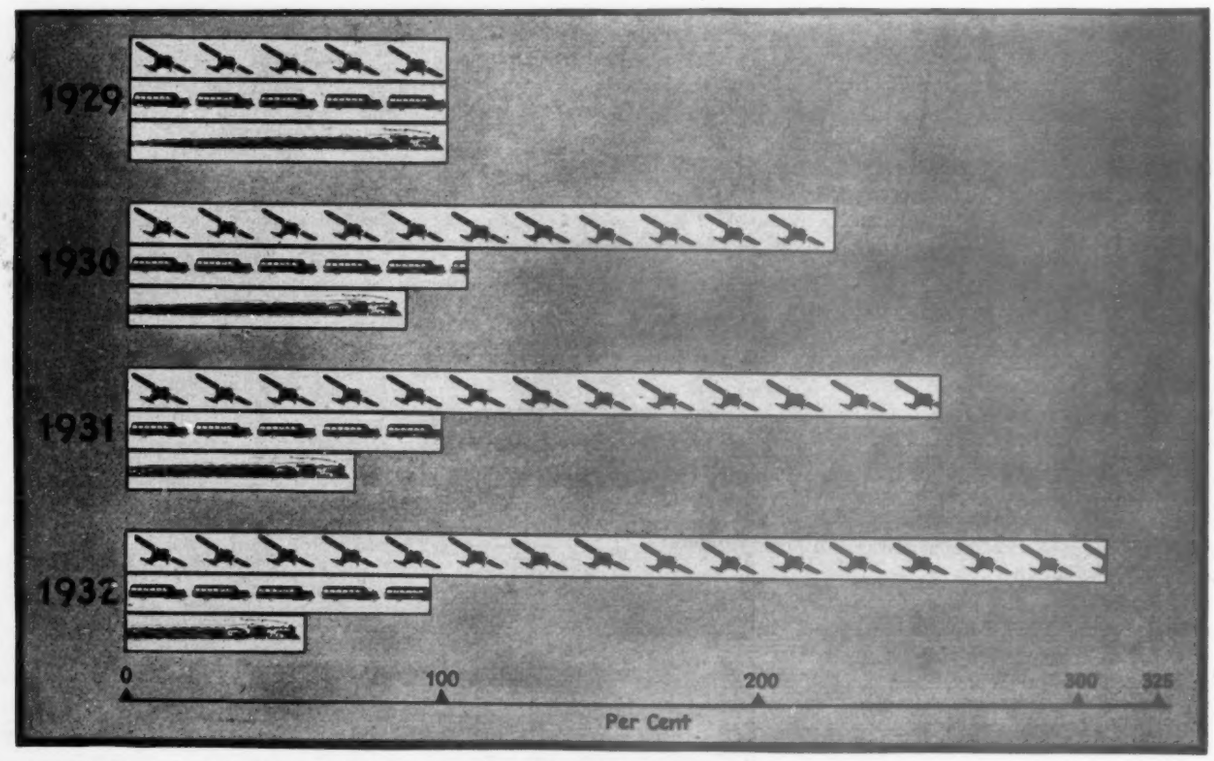
The map on page 69 suggests the speed and flexibility of air travel, and it serves also as a reminder of the rapidity with which speed is being increased at the present time. The increase of airplane speed progresses in a curiously irregular fashion, by a series of jumps. From 1920 to 1927, the typical cruising speed of commercial airplanes was 100 miles an hour or a little less. From 1928 to 1932 on the whole, it has run around 115 to 120 m.p.h. There have been faster machines in service, and there have been slower ones, but that has been the general rule. The summer of 1933 is now certain to mark another jump, to a typical new cruising speed of about 150 m.p.h. Allowing for all the necessary stops for refueling and change of passengers and cargo, coast to coast service in 18 hours is literally within grasp. As the travel map at the bottom of the previous page indicates, twelve hours from New York, a time that now carries the traveler to the Eastern boundary of the great plains, will suffice to get well out into the foothills of the Rockies. The East Coast of Florida is already only twelve hours away from New York, and will be brought within a ten-hour journey or less with the 1933 airplane.

Great as is the saving of time in domestic travel by air, a map of our foreign communications would show savings greater still. On a network of 20,000 miles of airways over Central and South America and the Caribbean, American pilots fly 10,598 miles a day with mail and passengers. They fly over mountains and swamps and jungles, where two hours of pleasant flight may cover as much ground as three days of



AIRLINE OPERATING PERSONNEL. Of the 7,044 transport pilots in the United States, 697 had regular employment on airlines during 1932. There are approximately one-half as many pilots on the airlines as in the Army Air Corps, and they have had, on the average, a far more extended flying experience. Their number has more than doubled in four years.

PASSENGER FARE. While air mail payments per unit of operation have been falling (as shown on page 71), passenger fares have come down also. The 1932 average of 6.2 cents a mile is even lower than it appears at first sight, for charges are based on miles actually covered, and often the distance by air is from 10 to 20 per cent less than by surface vehicle.

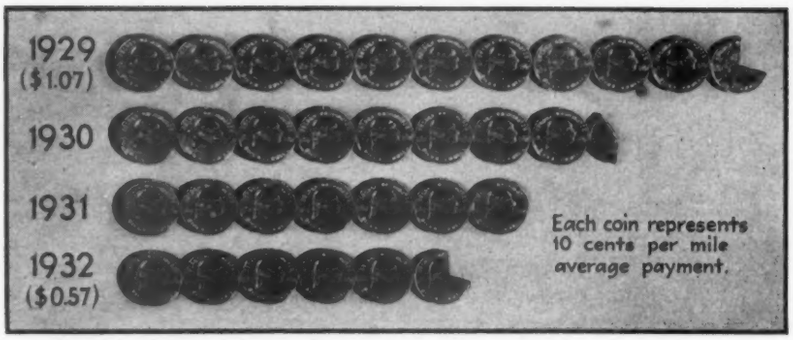


THE TREND OF PASSENGER TRAVEL, IN THE AIR AND ON THE SURFACE. The figures plotted are index numbers for the passenger-miles on airlines, railroads, and motor bus lines respectively, with the 1929 figure taken as 100 in each case. Passenger traffic on the airlines increased 210 per cent from 1929 to 1932, while that on the railroads was falling off by 46 per cent.

struggle along the surface. They serve, too, to link the great commercial centers of South America with a service like that which links the cities of the United States. Flying often over undeveloped areas where the operator must supply all his own ground organization, a single company has built almost a hundred airports, operates a radio system with 59 stations, and has invested $20,000,000 in equipment. The traveling public have not overlooked the effort made on their behalf. Last year, 62,976 of them flew on the Latin-American routes, and 78 per cent were business men traveling on commercial errands. The air mail has gained in popularity proportionately, despite high post-office surcharges. More than 3 per cent of all the letter mail between the United States and Latin America now goes by air.

Efficiency up, costs down

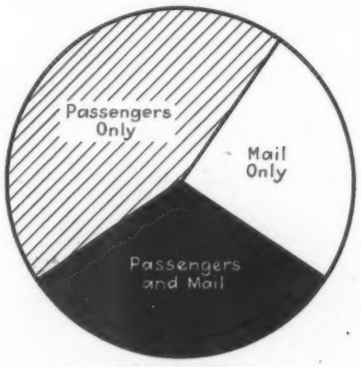
The increase in airline traffic in the past three years has been accompanied by a general tightening up of operations in the interest of efficiency and economy, a pair that often go hand in hand. The total number of planes in transport service has increased only about 20 per cent in two and a half years. The mileage flown is 50 per cent larger now than it was in the summer of 1930. At the end of 1928, 50,000 miles of flying per year per airplane would have seemed a very high total. For the whole year 1932 an average of 87,000 miles was flown by every machine owned by the transport lines, despite the fact that some of their planes were in reserve and very seldom used. There is no record that any other country in the world came anywhere near this figure of efficiency of utilization of equipment. Operators are by no means satisfied with the 1932 average, however, and are likely to double it again within the next two or three years. By 1935 an airplane that flies 15,000 miles in a month and keeps on doing it every month thereafter should offer no occasion for surprise.



PAYMENT TO DOMESTIC AIR MAIL CONTRACTORS. Despite steady increase in the size of the airplanes used, and so in the cost to be expected per mile flown, the actual payments to air mail contractors for the Post Office Department have declined each year without interruption. In 1929 the average payment was $1.07 per mile. In 1932 it was down to 57 cents—and still falling fast!

The picture that shows the variation in the rate of payment to air mail contractors gives evidence of the effect of half a dozen revisions in the Post-Office Department's payment formula since the Watres Act was passed in 1930. The average rate of gross payment, allowing nothing for the income to the government from postage, has decreased by almost exactly half in three years. As a matter of fact, however, the effective reduction is much more than that, for calculation of expenditure or of operating costs in cents per airplane mile is somewhat misleading. In 1929 a typical air mail plane was a single-engine open-cockpit machine, usually not accommodating more than 1,000 lb. of payload and often no more than 500. For operating that sort of craft transport companies were then receiving just over a dollar a mile—and needing it. Three years later at least half the mail was being carried in planes accommodating six or more passengers, most of them multi-engined and in some cases having a total payload of as much as 2 tons. Other things being equal, the planes of 1932 should have received from two and one-half to three times as much operating income per mile as those of 1929 to hold their real financial position unchanged, yet the Post-Office Department's payments per mile have been decreased by 50 per cent. The decrease in the payment per ton-mile of commercial capacity over that same period (a fairer basis of rating) is at least 75 per cent.

On the map showing the density of passenger traffic there are three routes denoted by the heaviest weights of line, indicating more than 50 passengers per day on the average. Though small as passenger traffic of railroads and motor

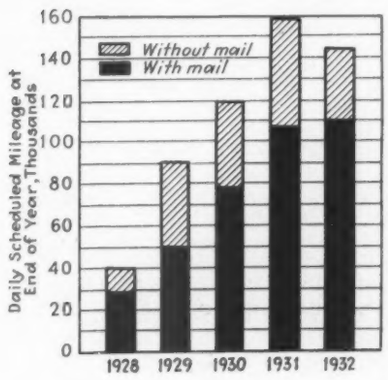


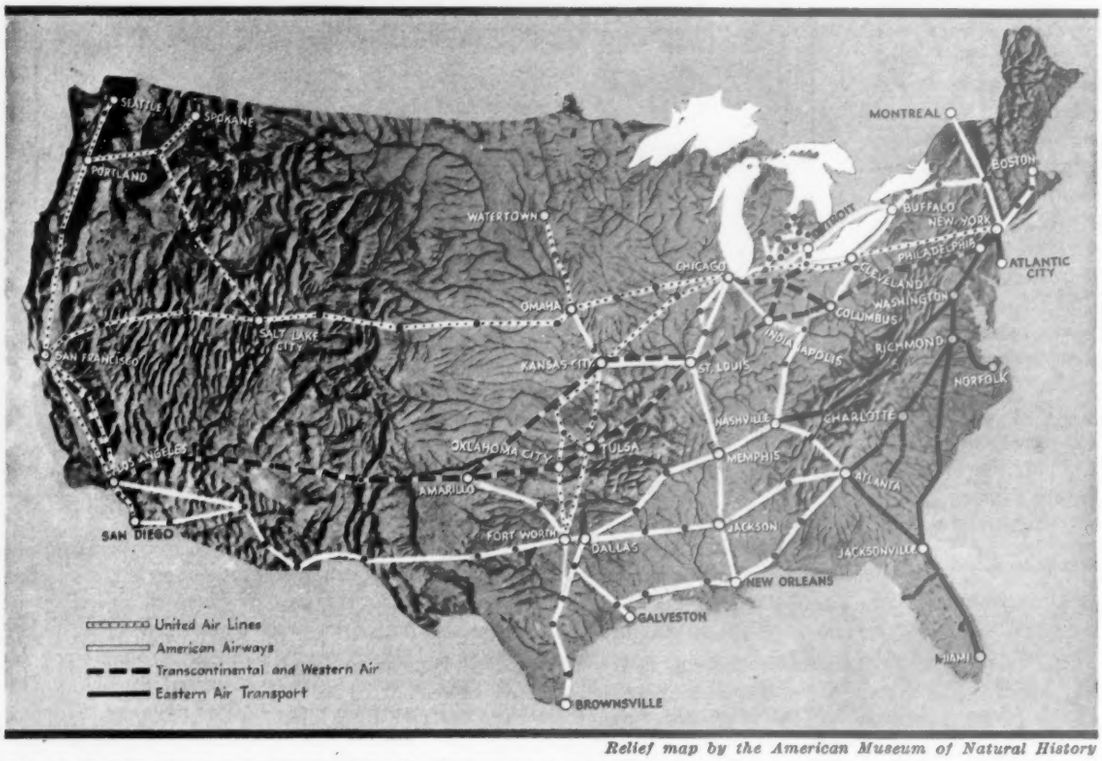
End of 1929

End of 1932

AIR TRANSPORT, BY CARGO. Three years ago most air lines carried either passengers alone or mail alone. Both of those types of operation have been decreasing in relative importance. The Post Office Department has encouraged the offering of passenger service on mail routes, and combined passenger-and-mail routes now make up 66.4 per cent of the total.

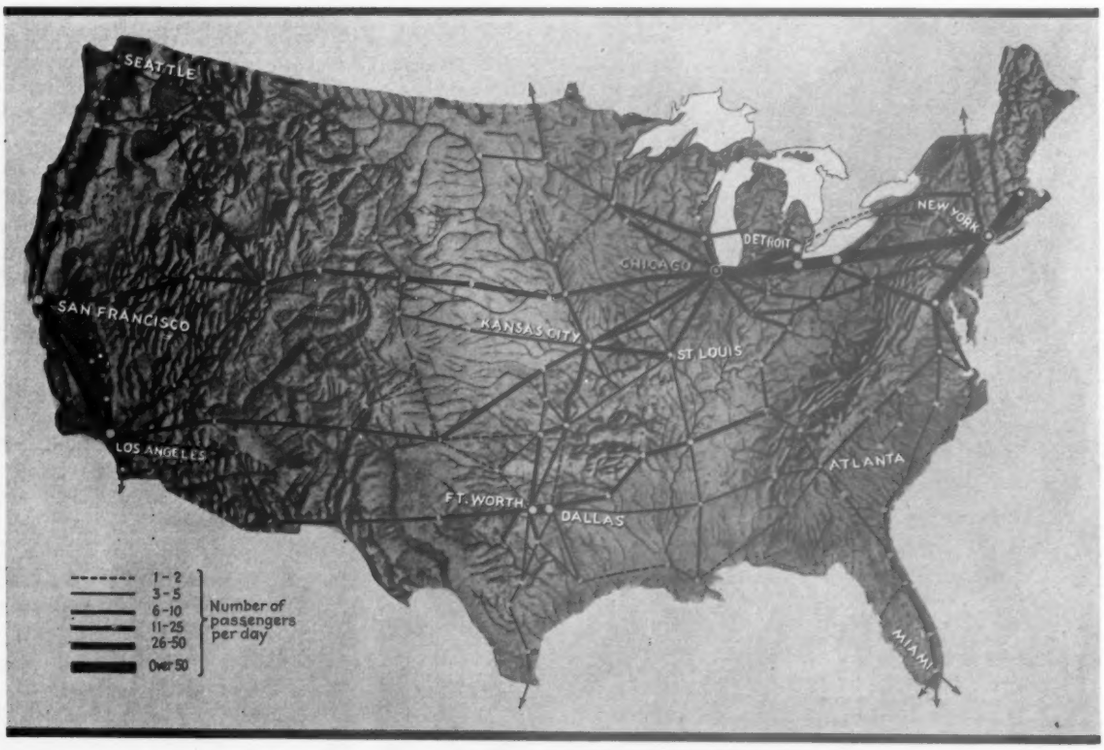
DAILY TRANSPORT MILEAGE. While the popularity of the airlines with the public has increased greatly during the past year, the scheduled mileage has been practically stabilized. At the end of 1932 it was 144,042 miles per day, equivalent to 28 round trips across the continent, and 76 per cent of it was being flown with air mail. Depression conditions have emphasized the present importance of the relation between the support of air mail and the continued growth of air transport.



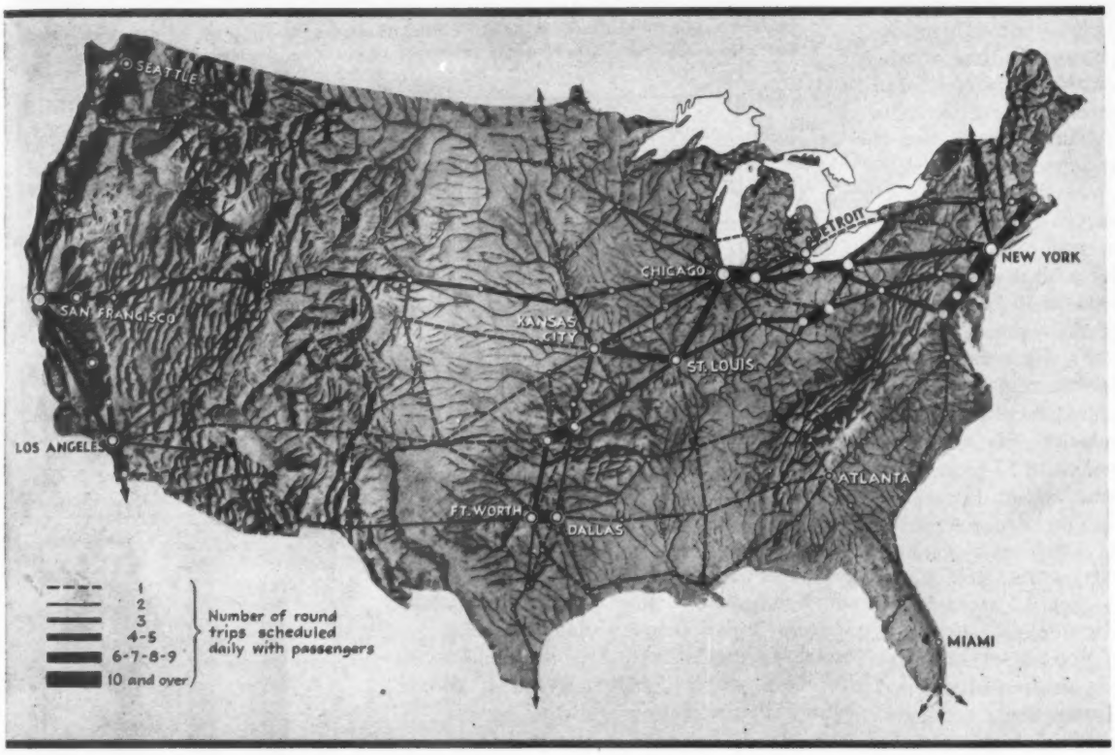


Relief map by the American Museum of Natural History

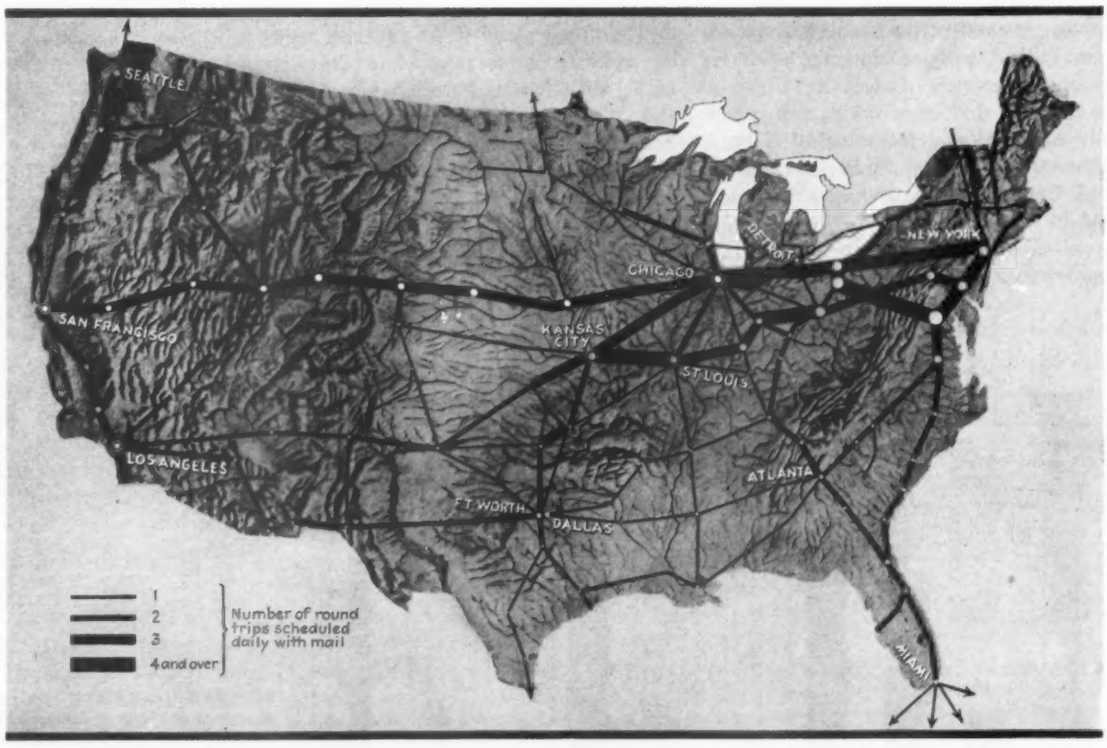
THE DISTRIBUTION OF AMERICAN AIR TRANSPORT AMONG THE FOUR MAJOR SYSTEMS, EACH OF WHICH TOUCHES AT LEAST TEN STATES.



AIRLINE PASSENGER TRAFFIC DENSITY. THE BREADTH OF THE LINE ALONG EACH ROUTE INDICATES THE AVERAGE NUMBER OF PASSENGERS CARRIED EACH DAY DURING 1932.



FREQUENCY OF PASSENGER SERVICE ON THE AIR TRANSPORT LINES, SIX ROUND TRIPS DAILY FROM COAST TO COAST.



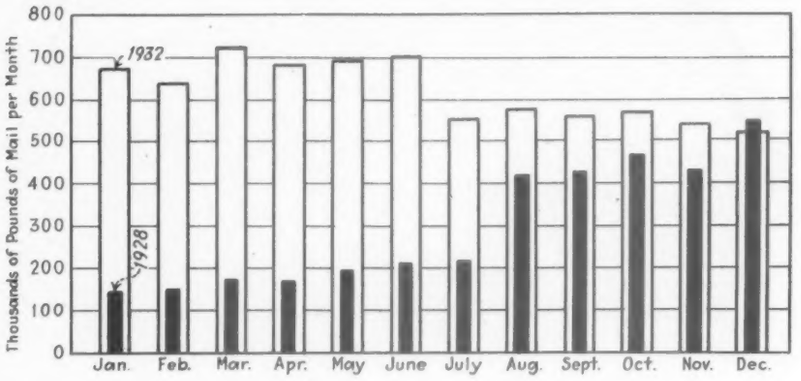
WHERE THE MAIL FLIES AND HOW OFTEN. THE AMERICAN AIR MAIL SYSTEM, THE INDISPENSABLE BACKLOG OF OUR WHOLE AIR TRANSPORT DEVELOPMENT.

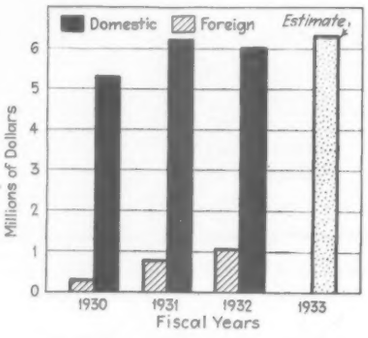
buses is measured, that is really a very respectable load, permitting a satisfactory frequency of service and supporting the maintenance of a thoroughly adequate supervisory organization on the ground without making the overhead cost per mile flown run to intolerable levels. Increased volume of operation is one of the master keys to the development of services profitable without government assistance.

As in 1931, the traffic last year was heaviest on the New York-Washington route, with its better-than-hourly service. The average throughout the year was 165 passengers a day between New York and Philadelphia, and 144 on the Philadelphia-Washington stretch. Next in order of popularity was the New York-Chicago route, with 57 passengers a day, and next came the San Francisco-Los Angeles flight, the two routes between those cities handling a total of 54 passenger per day. The New York-Boston run averaged 53 passengers. During the first six months of 1932, also approximately 75 passengers each day were carried by air between Miami and various points of the Caribbean area.

As might have been expected, the map showing frequency of service has very much the same appearance as that for traffic density. Where there are only five or six passengers a day there is no occasion for more than one plane in each direction, but a load of a hundred passengers cannot be handled by planes now typical without running a service at least once every two hours. It is to be expected that other routes will gradually be developed intensively, as those between New York and Washington, and Los Angeles and San Francisco, and in certain parts of the Great Lakes area, already have been. The main transcontinental routes in fact are now in process of rapid evolution into the intensive-operation stage. Passenger traffic will increase in consequence, as it has already done where the experiment has been tried. In 1931 there was an average of only about 30 passengers a day between San Francisco and Los Angeles. In 1932 the number had been nearly doubled. By 1934, assuming that no seriously disturbing factors are introduced in the meantime, we shall have a truly national network of airways all showing a normal traffic of 60 passengers per day or better.

AIR MAIL POUNDAGE AND AIR MAIL RATES. The sensitiveness of public patronage to postal charges. In August, 1928, the air mail rate was lowered and poundage (shown by the solid black bars) jumped. In July, 1932, the rate was raised from 5 cents to 8 cents for the first ounce, and the amount of mail sent (as indicated by the bars in open outline) immediately dropped 25 per cent. High rates do not bring commensurate increases in revenue, because they kill patronage.

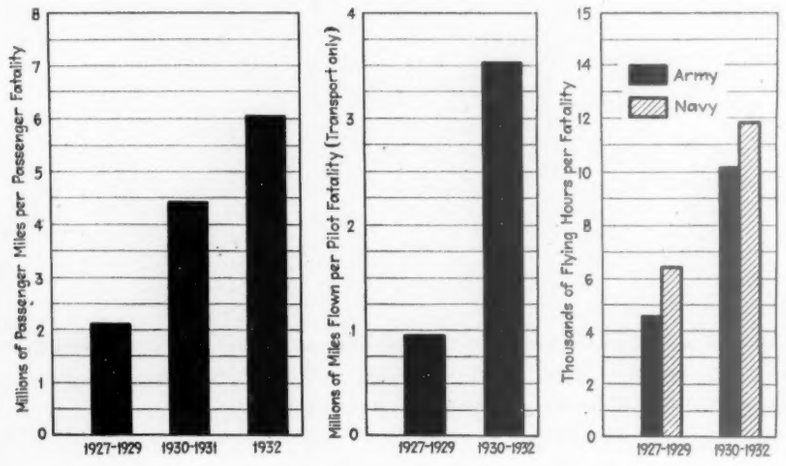




POST OFFICE REVENUE. In spite of the depression, increasing use of the air mail brings continued increase of income to the government. The present fiscal year will probably run ahead of any previous one on domestic mail income, while last year's income from foreign mail ($1,075,852) was three times that of 1930. All this, in spite of a decrease of 17 per cent in general postal revenues from other sources since 1929.

Air mail rates

It is almost fifteen years since the first air mail plane to be put into regular continuous service made the first flight with letters between New York and Washington. In that time there have been four or five sharp changes of policy towards the air mail. A great deal of experience has been accumulated, and it has taught many lessons. None is clearer or more important than that it is a futile business to try and make the mail service immediately profitable to the government by raising rates to the public. To do that is in terms of the old fable, to starve a goose that is capable of laying a succession of handsome golden eggs for the Treasury Department if only it be given proper nourishment while its golden-egg-laying powers are developing. Whenever the rates have been lowered, traffic has responded. Whenever they have been raised, the effects have been immediate and unfortunate. The hopes of air transport, and the provision of the best possible transportation service



GROWING SAFETY OF AVIATION. The average passenger hazard on American airlines in 1932 was only one-third the average of four years previously. Pilot safety on transport lines had increased in a like proportion, and the records of the Army and Navy have improved almost exactly 100 per cent in a three-year interval.

Mail carried in 1932

	Miles of service		Total weight of mail dispatched (pounds)	Average compensation per mile flown	
	Scheduled	Actually flown		1931	1932
American Airways					
1. Boston-New York	295,115	254,593	109,367	$0.68	$0.49
2. Chicago-Memphis	573,569	531,645	54,925	0.59	0.56
20. New York-Fort Worth	1,995,757	1,764,888	251,356	0.62	0.55
21. Dallas-Galveston	250,400	237,741	32,058	0.59	0.49
22. Dallas-Brownsville	409,954	397,360	79,032	0.63	0.54
23. Atlanta-New Orleans	319,980	300,138	82,304	0.63	0.46
24. Chicago-Cincinnati	405,942	363,753	60,144	0.64	0.50
29. New Orleans-Houston	242,964	237,650	44,916	0.48	0.46
30. Omaha-Atlanta Pt.I	1,352,130	1,248,352	249,286	0.60	0.52
33. Atlanta-Los Angeles Pt.I	2,943,074	2,800,426	324,525	0.87	0.64
Total	8,788,885	8,136,546	1,287,913	$0.69	$0.56
Eastern Air Transport					
19. New York-Miami	3,696,650	3,489,387	821,306	0.61	0.49
National Parks Airways					
26. Great Falls-Salt Lake City	745,711	728,270	50,638	0.58	0.48
Northwest Airways					
9. Chicago-Pembina	1,600,277	1,550,326	242,468	0.64	0.55
Pennsylvania Air Lines					
11. Washington-Cleveland	792,537	648,690	135,398	0.44	0.40
Transamerican Airlines					
27. Bay City-Chicago	1,541,619	1,385,460	150,941	0.54	0.43
Transcontinental & Western Air					
34. New York-Los Angeles	4,706,667	4,347,110	1,150,176	0.59	0.70
Western Air Express					
4. Salt Lake City-San Diego	754,532	742,399	78,679	0.90	0.51
12. Cheyenne-Albuquerque-Armarillo	631,082	593,941	112,154	0.60	0.51
33. Albuquerque & El Paso, Pt. II	162,726	158,220	9,304	0.79	0.63
Total	1,548,340	1,494,560	200,137	$0.83	$0.52
United Air Lines					
3. Chicago-Dallas	1,867,224	1,760,681	458,625	0.71	0.57
5. Salt Lake City-Seattle	1,285,582	1,242,211	249,859	0.78	0.60
8. Seattle-San Diego	1,793,952	1,755,330	401,183	0.66	0.55
17. New York-Chicago	2,445,296	2,184,585	1,149,149	0.82	0.56
18. Chicago-San Francisco*	4,635,395	4,521,740	1,076,795	0.92	0.67
Total	12,027,449	11,464,547	3,335,611	$0.81	$0.61
United States Airways					
30. Kansas City-Denver, Pt. II	465,196	447,395	18,889	0.40	0.32
Total	35,913,531	33,692,291	7,393,477	$0.70	$0.57

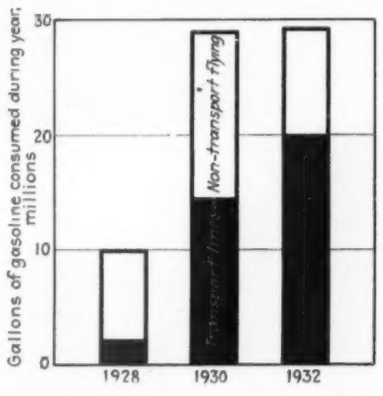
* Service between Omaha, Nebraska & Watertown, S. D., inaugurated January 16, 1932.

for the American people, depend on increasing the volume of operation and the volume of patronage. There is no possible way of making the service self-supporting at a higher rate. There is no possibility of making it self-supporting at a very low rate, providing no differential of charge for the exceptional treatment that an air-mail letter receives. *But at a properly-gaged intermediate rate, complete self-support can and will be realized.*

The present rates, established last July, are unduly high, and the air mail service is paying the price in lower patronage. It will be enabled to make a good record of income to the Post Office Department for the present fiscal year, and the direct income from domestic and foreign mail combined should run to approximately $8,000,000, but that record will have been made at the cost of alienation of an important part of the public. The air mail a year ago was running more than five times as high as in 1927. It can and should be multiplied by five again, but nothing of the sort is likely to happen at the present schedule of postal charges. A 5-cent rate for an ordinary letter is the very limit of what the traffic ought to be expected to bear, and there should be some cheaper standardized mailing-piece, either a post-card of a specially-prepared letter-envelope or both, which will go at a rate of not over 3 cents. That way lies hope and progress.

Although the Post Office Department's accounting system makes it impossible to be absolutely certain on the point, there appear from the available figures to be a number of air-mail lines which come very close to returning the Government a profit at the present time, bringing in very nearly 100 cents in postage for every dollar paid over to the contractor. If a self-supporting service is wanted at the earliest possible moment it could be secured within a couple of years by cutting off a number of the contracts running through the less densely populated sections of the United States, but the Congress and the Post Office Department have so far felt that it is of paramount importance that the special advantages of this extraordinarily rapid service should be made available to as large a proportion of the American people as possible, instead of being reserved principally for those who live in the neighborhood of a few great cities.

In the letter to the President which introduces this collection of material, it is remarked that air transport gives direct employment to some 6,000 people and indirect employment to nearly if not quite as many more. The exact determination of the amount of indirect employment connected with any industrial or commercial activity is of course impossible. We cannot hope to trace every article used in air transport back to the point where the raw materials came out of the ground. It is obvious, however, that aviation plays a large and growing part in consuming the products of many industries. Simply as a suggestion, one among many that might have been presented, the fuel consumption in air transport and in miscellaneous flying has been plotted at the bottom of the page. It has almost tripled in four years, and it has reached the point where almost all of the leading oil companies maintain special aviation divisions. If the figures on the fuel consumption chart are to be compared with the total production of petroleum products in the United States it must of course be remembered that in aviation, with its tireless search for the utmost in efficiency, the demand is for fuel of a much higher quality, and selling at a substantially higher price, than is needed in any other type of transportation.



AVIATION FUEL CONSUMPTION. During 1932 the transport lines alone were using over 1,000 barrels of gasoline a day. Half as much more was going into miscellaneous non-military flying, and another 700 barrels per day or thereabouts went to fill the tanks of military and naval airplanes (not shown on the chart)

Despite all depressions and other afflictions, the number of airplanes in service in the United States at least holds its own. Old machines are still replaced as they go out of service. At the end of 1932, 7,330 planes of commercial types were licensed for service, and another 2,994, were "identified" for non-commercial operation.

The value of American production of commercial and military airplanes (not including engines). The commercial business, like that of every other manufacturing industry, has felt the blows of the depression. The survival of the industry and its ability to preserve intact the organizations which are so great a potential factor in the national defense depend more and more clearly upon the stabilization at an adequate level of appropriations for military purchases. The present indication is that the production for military purposes in 1933 will go well below $10,000,000 for the first time since the postwar aircraft industry was created in 1926.

The value of American engine production, commercial and military. Here, too, commercial production has temporarily fallen off to such an extent that continued development of the art of engine design hinges upon continuance of military purchases. Even in 1932, the military production of $6,371,000 was 25 per cent below that of any previous year since 1926, but current budget policy seems to threaten still further reductions of a genuinely alarming nature.

What the factories are doing

Production records show growing dependence on military markets

THE last three years have been a period of transition in the airplane industry. The chart in the middle of the opposite page makes the transition graphic. In 1929 it seemed for the first time that aviation's long-awaited day of public awakening was really at hand. The sale of commercial airplanes and engines in 1928 had been four times as large as in 1927. In 1929 it doubled again. The idea of the private airplane had finally made itself felt, and it was being accepted with accelerating rapidity.

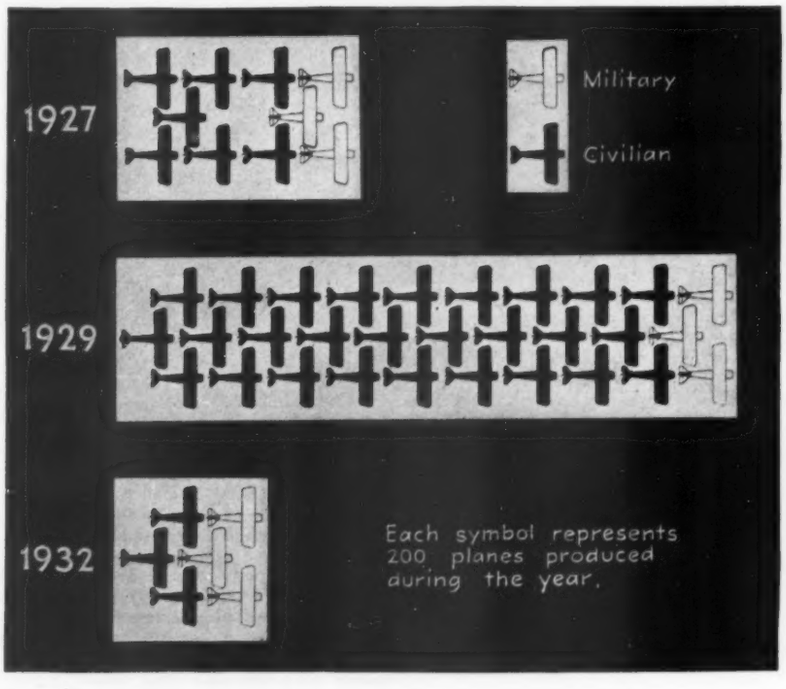
In aviation, as in other fields of economic endeavor, 1928 and 1929 showed some absurd and unnatural developments. There was some abnormal expansion; there was some over-production, even on the basis of the rapidly growing markets of the time; there was a perfectly preposterous multiplication of the number of independent manufacturing companies. Nevertheless all that would very probably have righted itself, the bright anticipations of the moment might very well have been essentially realized, and commercial aircraft manufacture might have remained on a footing which would have made military airplane production a minor auxiliary, had it not been for the general economic collapse.

The purchase and use of private airplanes was still something very new at the end of 1929. It had not yet had time to imbed itself into the human consciousness so that it could be taken for granted. It was listed, in most cases, among the "extras" of life, a luxury which could in case of necessity be laid aside for the time being. As the natural result of the fact that aviation was still a novelty, and of the tenuous position that novelties occupy at the time of a financial crash, the non-military sales of airplanes have dropped to barely one-tenth of the 1929 figure. In 1932 the commercial production of airplanes totaled but $2,337,899; that of engines but $2,898,371.

It seems quite certain that we have now passed the low point, and 1933 will see the first steps in the rebuilding of a really substantial commercial market. Transport lines of course have been making some purchases all through the period of the depression, but they use their equipment so intensively that even the present large amount of transport traffic can be handled with only about 500 planes, approximately 120 of which would normally be replaced each year. The transport demand alone cannot maintain an airplane industry strong enough to be a proper nucleus for possible national needs.

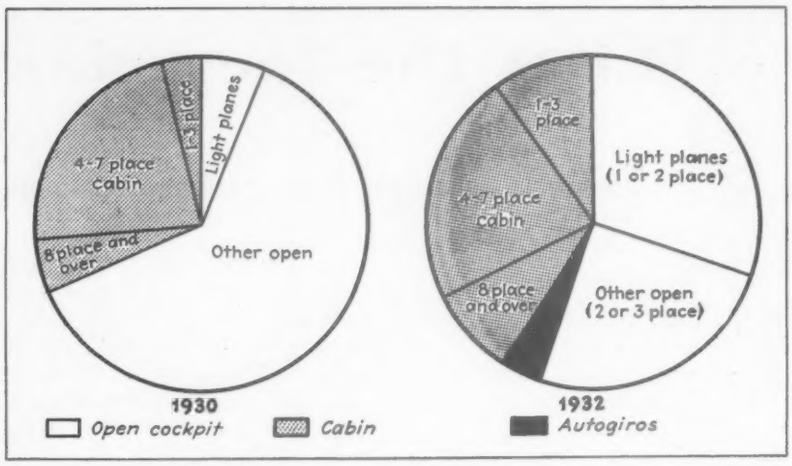
Inevitably, therefore, by the simple pressure of present facts and pending the rebuilding of the private market for airplanes to something like six times its present magnitude, the preservation of the American industry, and of the engineering organizations within the industry upon which technical progress so largely depends, must rest upon military production. As the charts on the opposite page show, the military demand was resonably well stabilized from 1927 to 1931, the years of greatest pressure under the "five-year programs" of the Army and Navy. Last year came the first signal of a rapid decline in military purchasing, and present appropriations make it probable that 1933 will fall to a materially lower level still. The crux of the problem is there. The continued development of the aeronautical arts in the United States, and the maintenance of an industry capable of adjusting itself to military needs in the event of war, now depend preeminently upon the Federal Government's future provisions for military and naval aircraft.

AMERICAN AIRPLANE PRODUCTION. In 1929 the demand called for the creation of an industry building 6,000 machines a year, and still growing. In 1932 private purchasers are temporarily out of the market. The industry must depend almost entirely upon its military connections, with military planes approximately equaling the non-military types in number and exceeding them in the ratio of four to one in value. Production for 1932 was 593 military planes, while of the non-military types 549 were produced in factories and about another 225 by amateur builders and home work shops.



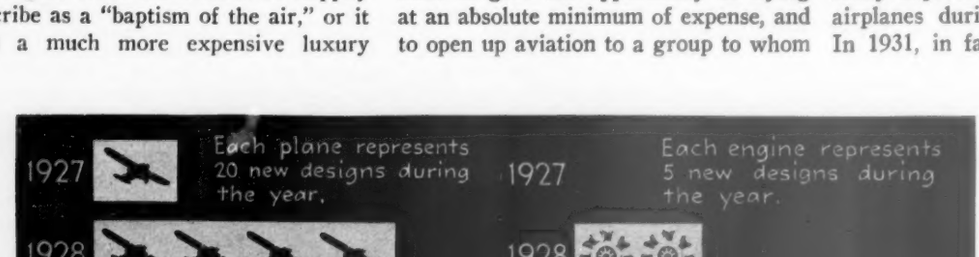
Commercial types

As the production of commercial airplanes has fallen off from 5,357 in 1929 to 549 in 1932 (excluding home-built machines in each case), distribution by types has also changed. The most conspicuous trend, as shown in the charts at the right, has been toward the displacement of open-cockpit planes by the less sportive but more comfortable cabin types. From 1928 through 1930, less than one-third of the planes built had enclosed cabins. In 1932 the cabin plane began what seems likely to be a continuing improvement in its relative position. The chart for 1932 also shows another comparatively new feature in the assignment of a 4 per cent wedge to the autogiro, which was quite unknown to the commercial market until two years ago.



DISTRIBUTION OF AMERICAN PRODUCTION IN 1930 AND 1932. Cabin planes, which made up only 30 per cent of the total in 1930, increased to over 40 per cent in 1932. Light planes, selling at very low cost, made rapid progress towards a monopoly of the open-plane segment. For machines for which the owner has been able to spend more than $2,000, the closed type, in which a heater can be installed and ordinary clothes worn, is dominating the field, just as closed bodies have come to dominate automobile production.

Although open planes made up from 65 to 75 per cent of the total production for a number of years, and still constitute well over a half of the total, there have been great changes in their character. In 1928 an open airplane was either a moderate-priced general utility craft equipped with a war-time surplus engine that could then be bought for a song, and generally used for instructing student pilots or for giving passengers what the French so happily describe as a "baptism of the air," or it was a much more expensive luxury craft of very high performance, and intended for sale to wealthy private pilots of sporting proclivities. As the chart at the top of the page indicates, 1930 brought the first venture in the manufacture of light planes, machines with engines of 50 hp. or less. They were built to give the opportunity of flying at an absolute minimum of expense, and to open up aviation to a group to whom it would have had to remain a closed book under any other conditions. In the next year there was a great rush of light planes of many makes onto the market, and some over-production which unsettled the situation during 1932 and was partly responsible for the abnormally depressed output of non-military airplanes during the year just ended. In 1931, in fact, almost exactly a half of all the non-military airplanes built were of the light-plane types, practically all of them selling at less than $1,800. In 1932 that category still made up a third of the total production. In the meantime the supply of war-time engines had been exhausted, and between the luxurious cabin-plane on the one hand and the extremely cheap light plane on the other, the heavier open types with engines of 80 hp. or more were being squeezed into a very small segment of the circle. They seem destined in future to hold the place that the open roadster holds in the automobile market, being sold in very limited

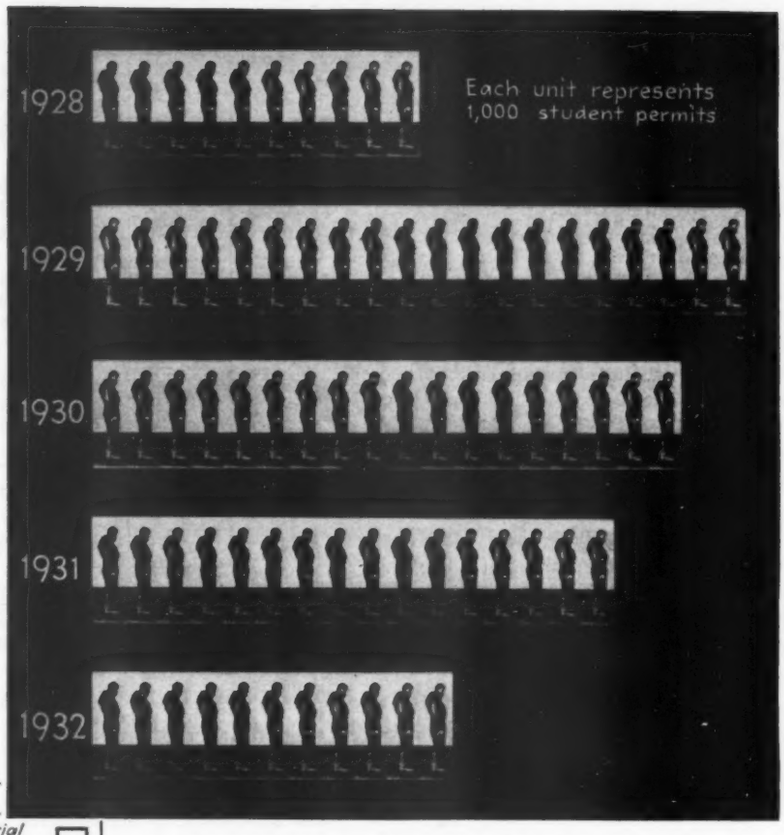


APPROVAL OF NEW AIRCRAFT AND ENGINES. In 1929, when new airplane companies were being promoted in every corner, a total of 188 new types of airplanes and 24 new engines were approved by the Department of Commerce for production. Such figures were absurdly large. As was necessary if economy was to be insured, fewer new designs are being put out now, and by fewer companies, but even in 1932 there were 38 new commercial airplane designs and sixteen new engines, figures quite adequate to permit of keeping abreast of technical advance and taking full advantage of new scientific discoveries. By way of comparison, it is interesting to note that all American automobile factories combined are offering only 71 types of chassis for 1933, numbers of them carried forward from last year without major alteration. The new airplane or engine is now carefully developed by the manufacturer through a succession of experimental stages before any public announcement is made or recognition sought, where once it was likely to be rushed immediately to production and sale.

quantities to those to whom flying is a pure sport, and who prefer to get as close to the elements as possible.

Developing new types

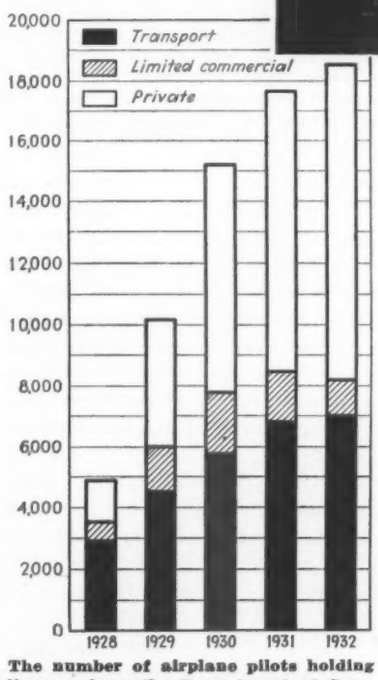
As suggested in the caption at the bottom of the opposite page, the decrease in the number of new designs submitted for the approval of the Department of Commerce is a wholly favorable symptom. In 1932 there were 38 new approved type certificates issued for airplanes and 16 for engines, and that is quite enough to keep abreast of the times. In 1929, both because of the urge to rush experimental machines immediately onto the market and because of the tremendous number of factories that were being started, the number of new airplane designs approved reached the really absurd total of 188. They represented 72 entirely independent factories. In 1932 the number of independent manufacturing units appearing on the list had fallen to seventeen, a further rational change in the interest of efficiency.



NEW STUDENT PILOT PERMITS BY YEARS. Though there has been an inevitable decline in the number of student permits from the boom years, when the pent-up enthusiasm of youth burst its bounds and thousands of young men rushed out to take advantage of a long-hoped-for opportunity to get into aviation, the decline has been very gradual. Even in 1932 11,259 student permits were issued, or at the rate (excluding for the moment the permits issued to women) of about one out of every 135 young men coming of age during the year.

Pilots, students

Despite the checks that the production of airplanes has undergone, there seems to be little if any check in the interest of individuals in learning to fly them. It was of course natural that there should be a great number of student permits issued in 1928 and 1929, and a very rapid increase in the number of licensed pilots in those years. Many men who had in fact been pilots for some years previously were just taking out their licenses under the spur of gradually tightening compulsion of state laws restricting the activities of those who failed to secure licenses. Also, many of the flying personnel of the Army and Navy were just getting around to taking their commercial "tickets," and many who had flown during the War were just refreshing their connection with the art and applying for permits or licenses. Most of those abnormal and temporary influences had subsided by the end of 1930, and it is a very encouraging sign of the real depth of American interest in aviation, and especially the interest of the younger generation, that the number of pilots still increased by 2,459 during 1931, and by 855 during 1932. It must be remembered that these licenses are not permanent, but have to be renewed every year, so that the total at any time represents personnel who are still showing a really active interest.



The number of airplane pilots holding licenses from the Department of Commerce grows every year. At the end of 1932 the total had reached 18,594, and 7,044 of them had transport licenses proving that they had done more than 200 hours of flying and were considered qualified to act as professional pilots.

The tendency to squeeze out the "limited commercial" group of pilots between the growing ranks of the transport license holders on the one hand and of the private pilots on the other is in itself an encouraging sign. The standards of skill for professional piloting are now so high that there is practically no chance of employement in the field by anyone who does not have at least the amount of experience required for a transport ticket,—and of course for employment on the transport lines themselves something like ten times that amount of experience is the minimum. At the other extreme are a great number of individuals who have no ambition to make money out of flying, but who are deeply interested in it as a sport or as a means of personal travel. They take private licenses (the number of which increased by 12 per cent during 1932) and a great many of them are quite content never to seek any higher grade, no matter how much flying time they have accumulated.

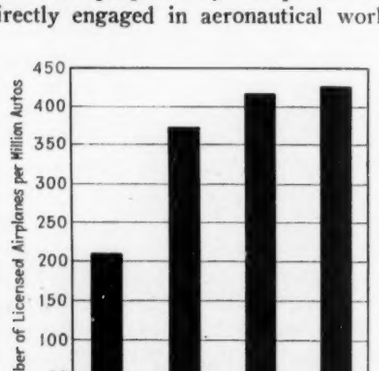
At the end of 1932, there were 8,038 student's permits in force. Practically all of their holders are potential pilots of the future.

Who uses airplanes?

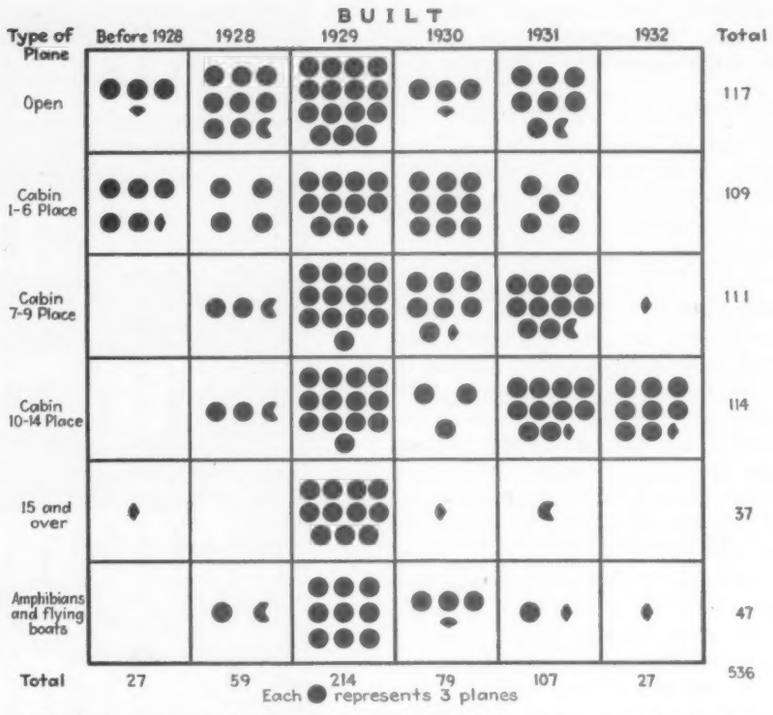
The 7,330 airplanes that are currently licensed by the Department of Commerce are being used for scores if not hundreds of different employments. Somewhere around a thousand to fifteen hundred of the total number are employed purely for pleasure. All the rest have some business purpose. Another fifteen hundred or so are privately owned, and used only for the business travels of the owner and his associates. Seventy are in the hands of various departments of the federal, state and the municipal governments, and 222 are owned by airplane manufacturers, some of them being used for company business, some for experimental flying purposes, and some simply being held while awaiting sale.

Most extended of all commercial employments of aircraft is the furnishing of miscellaneous flying service—taxi flying, special chartered trips with newspapers or express, aerial photography, crop-dusting and the like, as well as active sightseeing or "joy-ride" business. There are almost a thousand independent services of that sort, they use about 2,000 airplanes, and they have a very important place in the lives of their several communities. Another 200 planes, most of them of the small open-cockpit types, are employed exclusively in giving flying instructions.

Perhaps the most interesting group of all, because it is most varied in its employment, is the collection of airplanes that are owned and used for industrial purposes by companies not directly engaged in aeronautical work.



While airplanes have held their own through the last two years, the number of automobiles in service in the United States has fallen off. The ratio of airplanes to automobiles has steadily increased.



AMERICAN TRANSPORT PLANE DISTRIBUTION (type and date of manufacture). Though many planes built in 1928 and 1929 are giving splendid service, the process of replacement is going forward rapidly. Most of the passenger machines now in regular use are less than three years old, and more new equipment is scheduled to go into service in the next six months than in any other like period since 1929. The chart shows plainly how the relative importance of the open plane has decreased with the growth of the passenger traffic and the gradual opening up of the air mail lines for carrying passengers along with the mail.

There are 165 of them. Two-thirds of them are cabin planes, and 21 accommodate seven or more passengers.

Largest users of airplanes among the industrial group are the oil companies, with 74 machines of all types, open and closed, large and small, landplane and amphibion. About two-thirds of the oil company planes belong to national companies engaged both in producing and distributing, while the others are kept in daily service by various independent drillers for the transportation of themselves and their materials.

Airplanes in business

Next in order come makers of machinery of various types, and especially of oil-production machinery, with eleven airplanes. Newspapers hold six planes in their own names, in addition to being very frequent lessees of the machines operated by local flying services when the need suddenly arises to cover a story at a distance. Banks and investment companies have five; makers of automobile accessories six; moving picture companies three (they also are among the most constant patrons of airplane hire services); public utilities four. Miscellaneous groups with one or more airplanes owned and in regular service cover practically the whole gamut of industry, and include rubber companies, insurance companies, dude ranches, manufacturers of storage batteries, manufacturers of soft drinks, dealers in sand and gravel, truck haulage firms, general contractors, makers of electrical machinery, railroads, coal companies, and real estate brokers. Given a sympathetic hearing and a real opportunity, the airplane seems to have been capable of digging out a niche for itself in almost any type of business.

American transport companies, including those located in Alaska, Hawaii, and the Philippine Islands, and Pan American and Pan American-Grace, with many of their airplanes permanently stationed in South and Central America and in the West Indies and Mexico, have 536 planes licensed at present. Their general grouping by types and by years of manufacture is indicated in the square and dot chart at the top of the page. Of the cabin machines built prior to 1929 which are still upon the rosters of the operating companies, practically all are now in

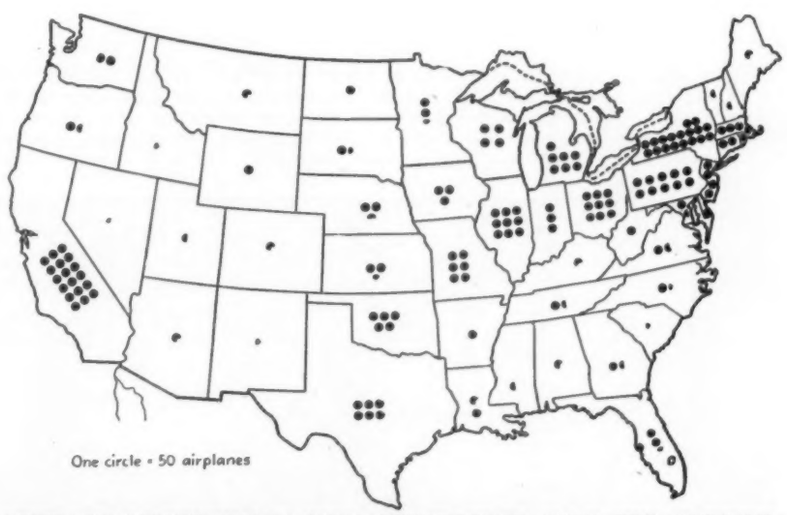
reserve. 1929 was the year of the great air transport expansion, and the demands for new transport equipment ran almost beyond the capacity of the available factories. Naturally the airlines fully stocked up at the end of that year had little need for replacement in 1930 and 1931, and although their operations were expanding quite steadily they were also learning how to get more service out of the same equipment and making the same number of airplanes do the increased amount of flying. Replacement purchases began to play a part in 1931, but it is only with the beginning of the present year that their whole force is really being felt. So rapid has been the advance in the aeronautical arts within the last couple of years that planes three or four years old, though still perfectly safe and sound, are considered as obsolescent on grounds of economy. The notable progress toward self-support of air transport that has been recounted elsewhere can only be continued if the airlines are kept in a financial position to make a rapid turnover of their equipment, and to allow older material to pass out of service on grounds of obsolescence whenever material improvements in economy have become possible through the adoption of newer types. 1933 and 1934 promise to be the great years of replacement of the last of the 1929 equipment, and present indications are that by the end of the present year at least 100 machines of 1933 production will be in transport service. Practically all of them will fit into the three spaces of the chart that cover the cabin machines accommodating seven or more passengers. The day of the open mail-plane on the transport lines is passing. Not a single one went into service during the past year, and most of those built in 1929 and earlier years will disappear and be replaced by cabin machines designed for mixed passenger and mail service within the next year or two, always assuming that the air mail is continued in something like its present status. The transport planes of 1933 manufacture will, in almost every case, be from 25 to 50 per cent faster than the four-year-old planes which they are replacing. A chart on page 69 gives evidence, in very practical terms, of what that means to the traveler.

How the planes are built

The business of manufacturing transport planes is widely enough diffused so that there is no sign of monopoly, while at the same time that uneconomical scattering of effort which was a danger in 1929 no longer threatens in any very serious degree. Eight companies account for 80 per cent of the airplanes now used on American transport lines, and that is just about the same number that are actively seeking to develop a market for new transport planes at the present time. Five producers now have more than 40 machines each in transport service.

There is a similarly wide distribution in the manufacture of private planes. Of the 549 machines which issued forth from American factories in 1932 for non-military use, no one factory built as many as 20 per cent. The ten leading producers were scattered among five states. Of the ten leaders in numbers of machines, four build light planes only; two build only cabin machines; and the other four have a mixed outlet. Only one of the groups leading in private-plane production has any share in the American military market, and in that case the military and the commercial work are done in different factories. For under present conditions, with the private market as small as it now is, it has proven to be most uneconomical and generally undesirable to mix a military and a private-plane business in the same plant. The building of planes for the Army and Navy involves problems and obligations which do not exist in the same form in making low-powered and low-price machines for private sale. Such craft can be produced more efficiently in a small plant that does not attempt to maintain the elaborate organization that is indispensable in connection with present military production and still more indispensable in order that a factory may be an effective unit in a national military plan, to be relied upon to expand with the necessary rapidity and flexibility to adjust itself to any demand that may arise in the event of war. So it is that the American industry, in the interest of getting the most and the best results for the least money all around, is divided into two main groups. On the one hand there are about nine factories preeminently concerned with military manufacture; on the other, there are some twenty or thirty companies, some of them quite inactive for the time being, that occupy themselves almost entirely with non-military work and especially with planes of the smaller types. Most of the builders of transports are in the first group, but a couple of leaders in that field are in the second. Aside from one or two instances of common ownership of commercial and military factories, the closest liasion between the commercial and military products comes in the export trade, where several South American countries have found American commercial airplanes, with minor modifications or none at all, to be admirably suited for certain military uses under the special conditions that confront their air forces.

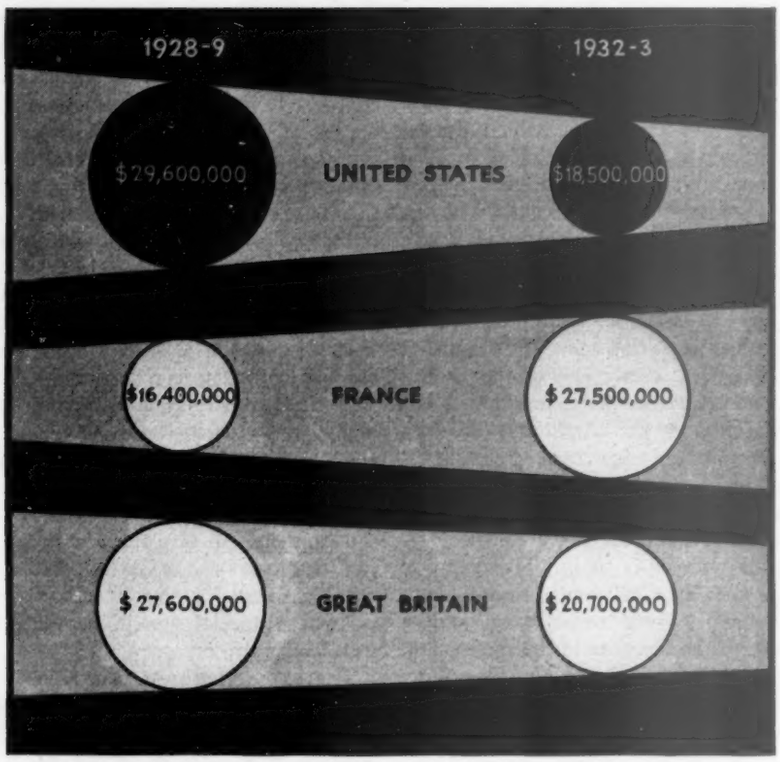
The export business was a veritable life-saver to the American industry last year. More than a quarter of the total product went abroad, much of it to equip airlines in Europe and in South America. There could be no higher tribute to the quality of American planes, for the competition with British and French and German and Italian products is keen indeed.



AIRPLANE OWNERSHIP IS WELL DISTRIBUTED OVER THE COUNTRY. There are but four states that have less than 25 airplanes licensed. California and New York run a close race for first place, but eighteen other states have over a hundred planes each.

The Army and Navy carry on

Appropriations for new equipment cut



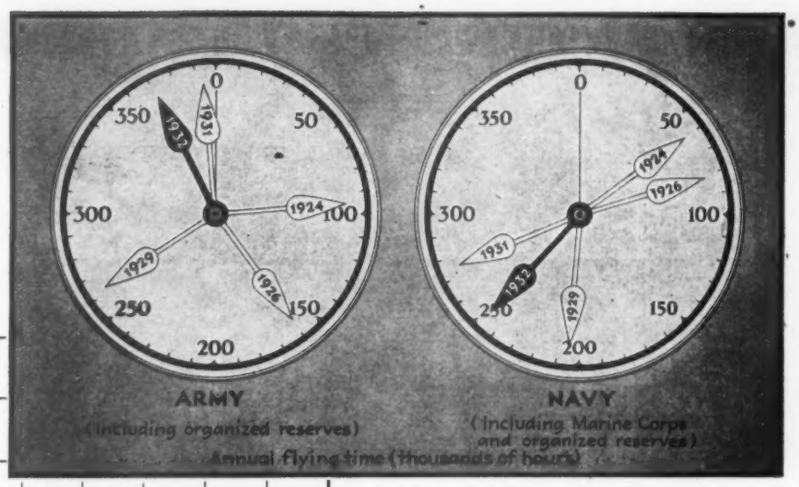
WHAT GREAT POWERS HAVE SPENT AND ARE SPENDING. Four years ago America was among the foremost in building a modern air force and keeping it up. Today, contracting appropriations threaten us with rapid decline to a rear rank. The apparent decline in the British outlay in the last four years has been largely due to the decrease in the gold value of the pound. Measured in British currency, the sums made available show a little decline, but a very small one, over the period selected. Even making comparison on a basis of gold value, with no allowance for differences of local purchasing power, American appropriations for new equipment are now far inferior to those of Great Britain and France.

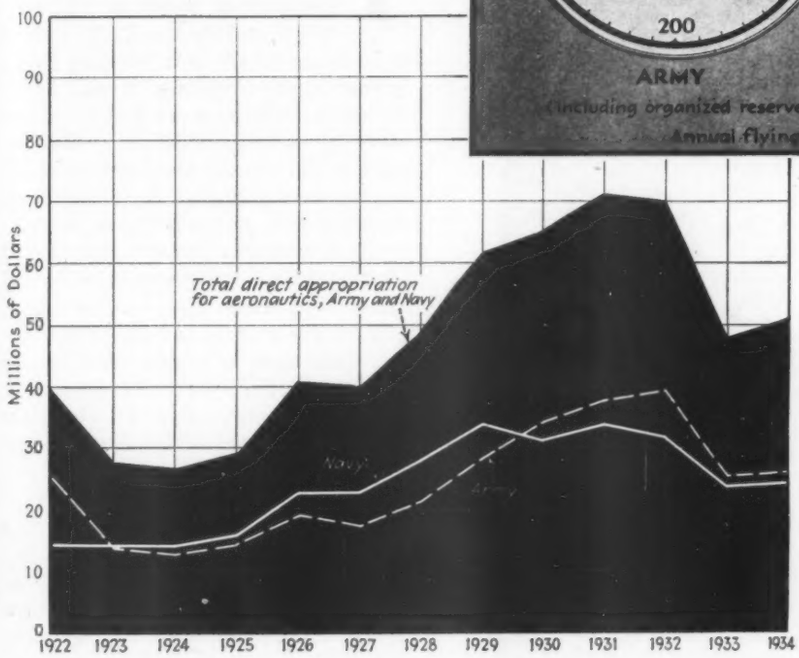
THE past year has marked the beginning of a new and extremely critical period for American military aviation. The Army and Navy have both had their five-year programs. The Navy's is complete; the Army's, hampered by limited appropriations, is limping towards completion about three years late. At this point it becomes easy and natural for those who are not in immediate contact with the problems of the Services, or do not of necessity follow all developments of military aviation, to feel with satisfaction that *that* job is done, and that we can now turn our attention to other matters.

Unfortunately the development and maintenance of an air force is no static undertaking. The past two years have been a period of extraordinarily rapid progress in airplane design. In the light of the performance of the latest types now being tried by the Services, at least 80 per cent of the machines that were in the hands of the Army and Navy last summer must be considered as either actually obsolete or just about to become so. Within the next three years there must be a virtually complete turnover in the equipment of our air force, unless some squadrons are to be left equipped with definitely inferior material. A normal rate of replacement and modernization of equipment under

MONEY MADE AVAILABLE FOR NEW AIRPLANES AND ENGINES FOR THE ARMY AND NAVY, BY FISCAL YEARS. Shrinking rapidly since 1929, the funds for new airplanes and engines for the Army and Navy have now shrunk back to the level of 1926. The situation is really more menacing now than seven years ago, for at that time the services could still draw upon almost unlimited war stocks of Liberty engines and airplanes of a variety of types. Expenditures at the present rate cannot hold American air force equipment up to its present levels, either in quantity or in quality.

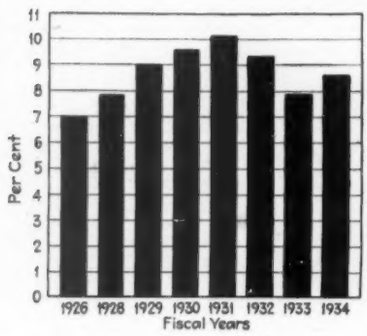
Still expanding the scale of their operations until 1931, the Army and Navy both had to cut down flying time during the last fiscal year because of reduced funds. From a total of 669,000 hours of flying in the two services in 1931, they have slipped back to 619,000 hours in 1932. That still amounts to an average of 190,000 miles flown every day of the year, but it is only about a little under 200 hours for each regular service pilot, scarcely enough to be sure of maintaining the highest efficiency.





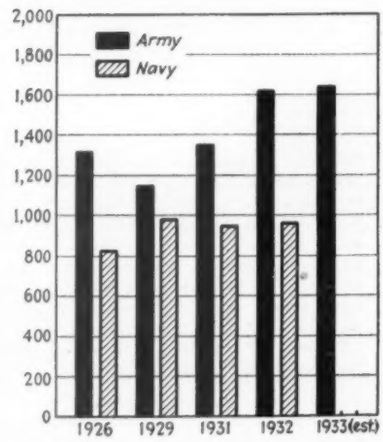
APPROPRIATIONS FOR MILITARY AND NAVAL AVIATION (1934 figures represent budget estimates). Including all allowances for maintenance work and operating supplies, appropriations are back to the level of 1928, when the services had much less responsibility and much less varied operations than at present. Appropriations for equipment alone have been cut still more drastically, as shown elsewhere.

AVIATION'S SHARE OF BUDGET. While the relative importance of aviation has, by agreement of experts, been going up, its proportion of American military appropriations shows a distressing tendency to fall. In this fiscal year, and also in the next if the present budget estimate holds, aviation's share of the national defense appropriations will be lower than in any one of the four previous years.



present conditions, not in any sense an extreme or an extravagant one, will call for the purchase of about 800 to 1,000 airplanes per year for the two services in each of the next three years. The cost of such replacement purchases would run to about thirty million dollars a year, or about the same sum that was spent on new equipment each year until two years ago. The Army and Navy have not been asking Congress for any such amount because the Bureau of the Budget has refused to permit them to do so, but that does not affect the fact that if appropriations continue at the present rate we shall soon have an air force very largely obsolescent in its equipment.

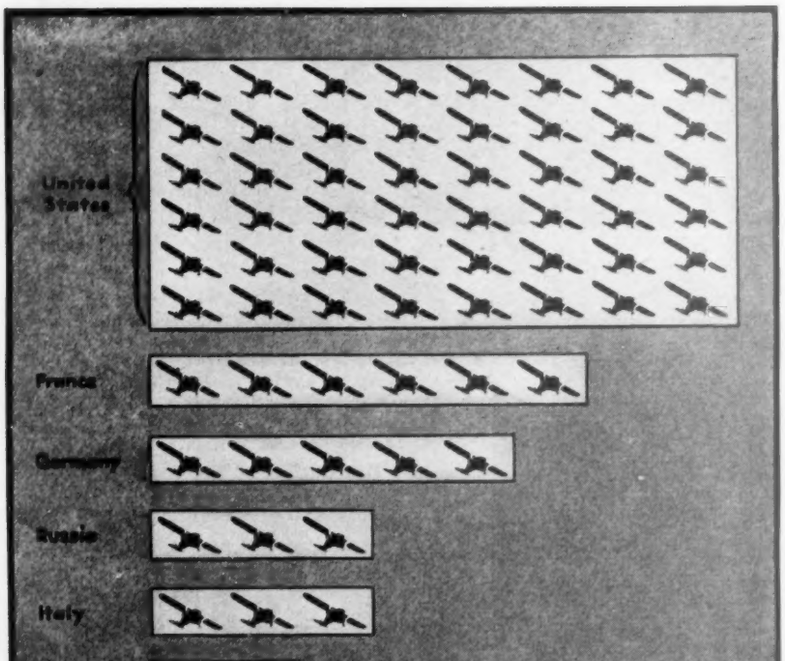
Furthermore, present appropriations, sharply cut by nearly 40 per cent from normal levels of two or three years ago, take no account at all of changing quantitative standards. The framers of the five-year programs of 1926 did their best, but they were not gifted with second sight. They could not take account of every world development and of every innovation in the military employments of aircraft, or of every new indication of the growing relative importance of aircraft, that would manifest itself over the next five years. Today we are in the absurd position of having almost completed a new aircraft carrier for the Navy for which Congress has not authorized a single airplane. That ship can be given even the smallest of complements with which to gain operating experience only by robbing other naval air units of a substantial part of the equipment assigned to them during the past four years. The Army Air Corps encounters similar dilemmas, as new responsibilities can be met only by whittling down the force available for bearing old ones.



PLANES ON HAND AT YEAR ENDS. While new evidences of the extraordinary importance of aviation in military operations have been apparent in all quarters, and the quality and efficiency of the equipment have made great advances, the end of 1934 still threatens to find the Army Air Corps 111 airplanes short of fulfilling a five-year program which was to have been completed in 1932.

America takes the lead in world air

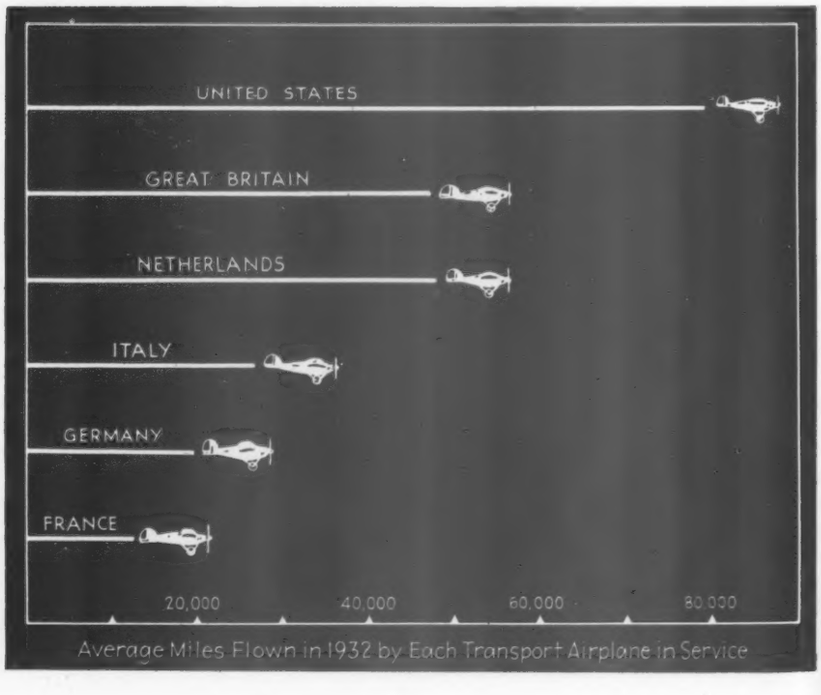
More flying, more passengers, more mail



AIR TRANSPORT MILEAGE. While American transport lines were flying some 48,000,000 miles during 1932, all the rest of the world combined was running up about two-thirds of that figure. Next in line was France, with approximately 5,530,000 miles.

THOUGH we are lagging behind certain European countries in our current provision for military aviation, we have nothing to be ashamed of in a comparison of records of non-military flying, be it transport, industrial, or private. The American who in defiance of the evidence of his own eyes and ears periodically asks why Europe is so far ahead of us in air transportation, or why people don't travel by air in the United States, is still encountered occasionally, but he is a much less common figure than he was four or five years ago. At that time there was some real reason for his existence, but European air transport has been comparatively stable over a long period while ours has been making its most rapid growth.

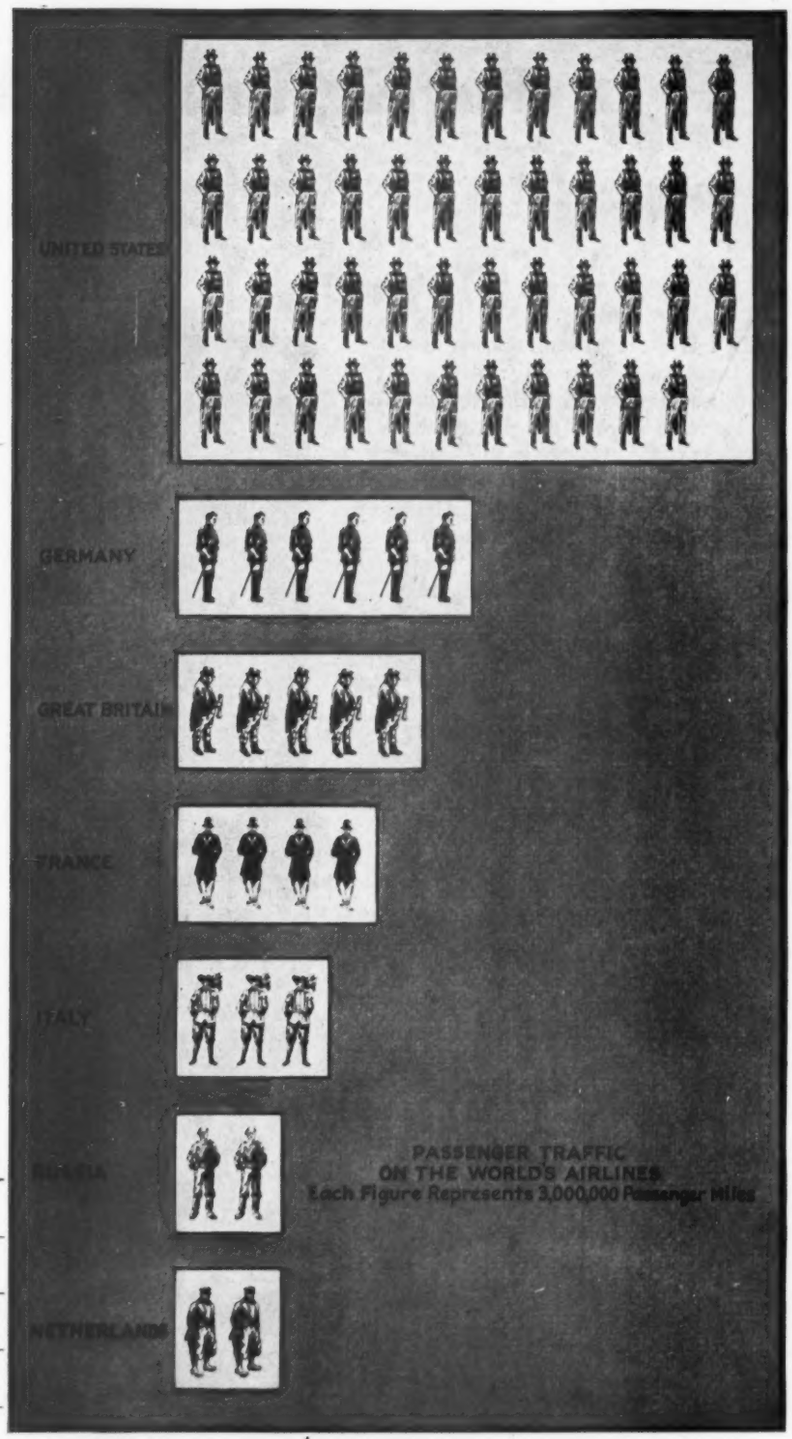
Mere volume of operation is of course relatively unimportant. America is a large country, and it takes a lot of mileage to cover it. What is much more important is the volume of service to a typical community, and the economy with which that service is rendered. The brightest spots in the story of American aviation are not the simple totals of miles of passengers carried,



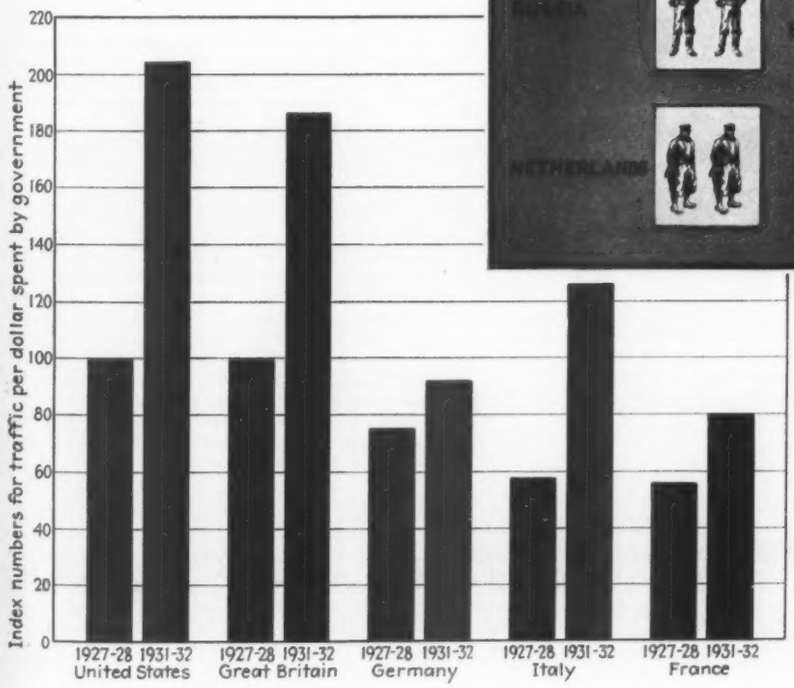
Though America has more transport airplanes in service than any other country, American machines are also used more intensively than those under any other flag. The average distance flown by each American transport airplane in 1932 was 87,000 miles, or three and one-half times around the earth. Great Britain and the Netherlands, next in efficiency of employment, show figures one-third lower than the American ones.

transport

but rather the fact that the per capita use of air transport by the citizens of the United States is more than four times that of the people of any European country; that the average American transport airplane flies more than 50 per cent farther in a year than the average plane of any European transport enterprise; that the American taxpayer gets more return in actual service rendered for every dollar put into civil aviation by the government than does his fellow taxpayer anywhere in Europe, and more than twice as much as in any other country except in Great Britain; and that the per capita ownership of civil airplanes in the United States is more than twice that of any European state, with Canada also exceeding any country in Europe in that respect.



What the taxpayer gets for his money in aviation. Comparison of the total airline traffic, in ton-miles of passengers, mail, and express, per dollar spent by the national governments. In spite of depreciated currencies and consequent lowered levels of costs abroad, the American traffic per dollar runs well above that of any European country, with Great Britain a good second. Note that the net expenditure per unit of traffic in the United States now is less than one-half what it was four years ago.

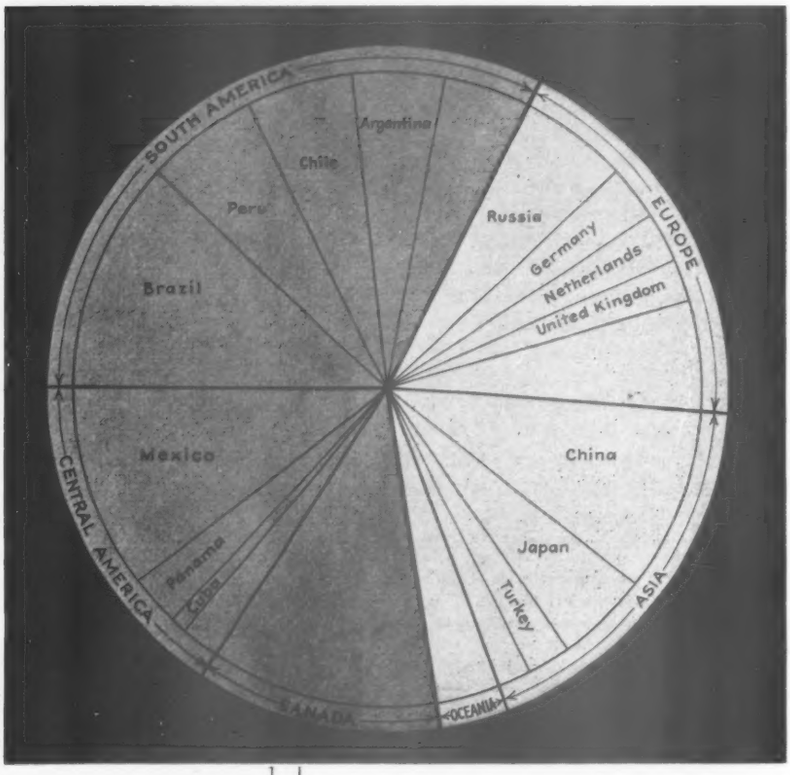


PASSENGER TRAFFIC. America has an easy lead over all the rest of the world combined in the number of passengers carried and the passenger-miles flown, and American traffic has been growing much more rapidly than that of Europe. Only five years ago there were three European countries which were ahead of the United States. Germany is now second, with approximately one-eighth as much passenger traffic as the American lines show. The British airlines, third in world standing in traffic though only seventh in miles flown, carry more passengers per airplane on the average than those of any other country.

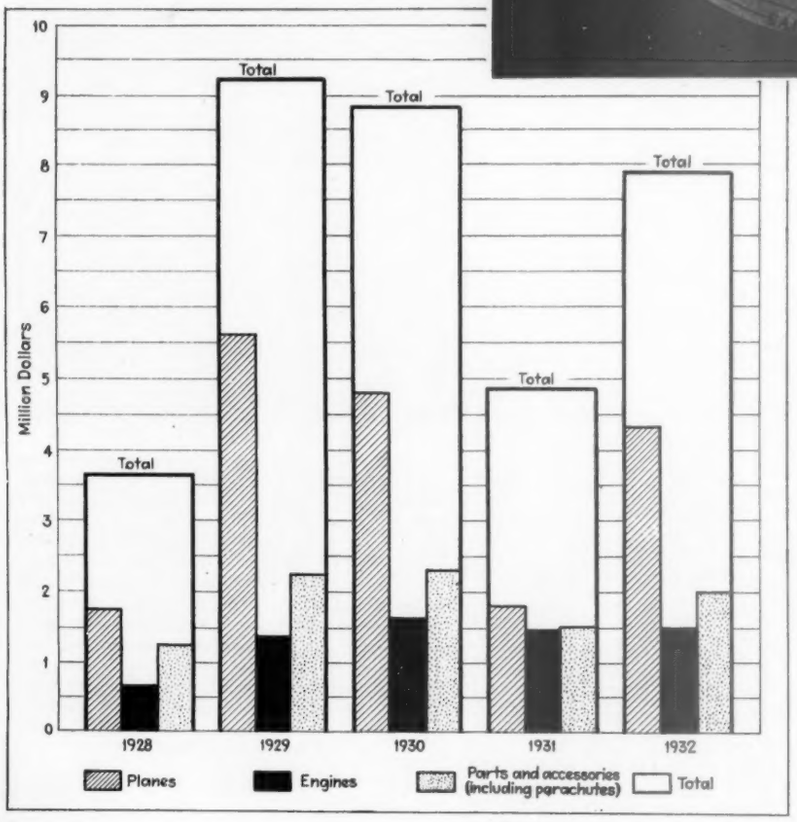
Foreign trade in 1932

A banner year

THAT the aircraft export business was able to make good headway against the economic stream during the past year is the best possible evidence of the esteem in which American airplanes and engines are held throughout the world. Almost exactly one-third of the total airplane production of American factories (in dollar value) went abroad, and approximately one-sixth of the total engine production. Neither fraction had ever run anywhere near so high before. While military shipments to South America accounted for much of the industry's prosperity, commercial business continued to play an important part, especially on engines. Continued development of the foreign market is among the most important factors in determining the industry's future progress and its ability to keep itself in readiness to meet sudden American demands.



WHERE EXPORTS GO. The average distribution over the last four years by continent and country. Canada and Brazil are almost tied for first place,—Mexico third,—China a good fourth. Russia, despite non-recognition, leads all the rest of Europe. South and Central America account for almost exactly one-half the total.



PLANES AND ENGINES AND PARTS. Though the total of all American exports in 1932 was off 60 per cent from the pre-depression high, the shipments of aeronautical products abroad were but 15 per cent below the 1929 figure and more than 60 per cent above that of 1931. Engine sales abroad have shown no depression effects at all, and have remained almost constant for four years as American power plants become more and more popular in foreign military and commercial services.

Twelve hundred airports

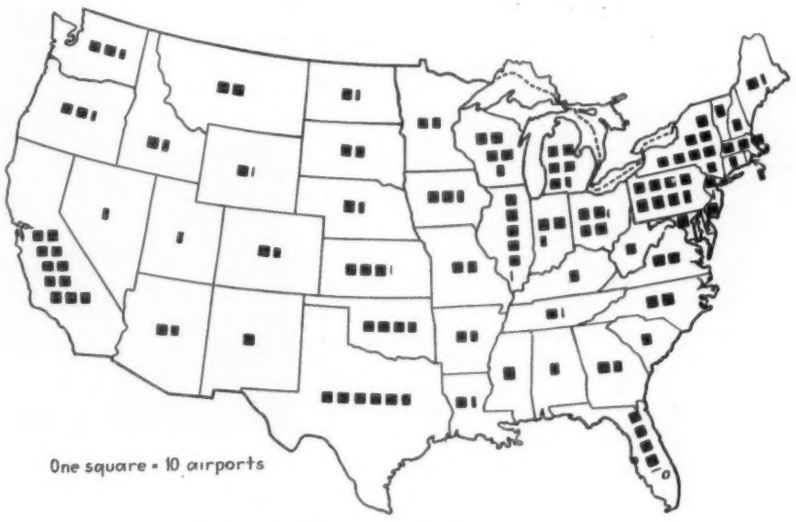
And 20,000 miles of airways

AIRPLANES are tethered to airports. Without airports, and plenty of them, aerial operations become haphazard and dangerous. With second-rate facilities the operators of aircraft are likely to be limited to second-rate patronage, and private owners get second-rate service. The airport has long been recognized as the very heart of the aeronautical problem, and it is with considerable satisfaction that we can celebrate the progress that has been made.

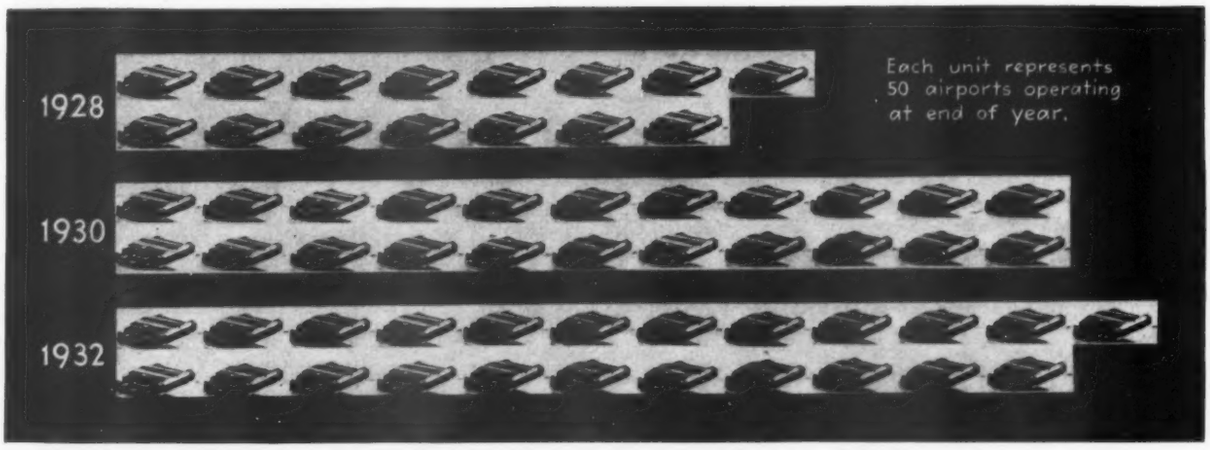
A total of 1,164 airports are now in service in the United States—545 of them municipally owned and operated, and 619 commercial. They represent an aggregate investment of about $150,000,000. To justify that investment and to realize a return upon it aviation must continue to move forward. The best economy, from the point of view of the municipality that has built and maintains an airport, is in providing the necessary inducement for airplanes to operate there in order that citizens and visitors may really get the fullest benefit out of the city's new utility.

That is so generally realized that even the hardships of the last three years and the constant pressure that has been exerted for greater economy by all divisions of government have had very little adverse effect on the airport situation. A few fields have had to be shut down here and there, but new ones are being opened up all the time. At the end of 1932 the total number of ports in service is about 200 above the total at the time, three years earlier, when the first signs of economic catastrophe appeared on the eastern horizon.

A regular airport with certain fixed installations is necessary as a base of operation for an airplane, but any clear



THE DISTRIBUTION OF AIRPORTS. Though 10 states have over 40 airports each, fields are still far too thinly distributed over most of the area of the country. If a state on the map above is well filled in with squares (as in Rhode Island and Massachusetts), it still indicates only one airport for every 200 sq.mi. of territory, or about one every fifteen miles in each direction. Practically every state ought to be able to do as well as that.

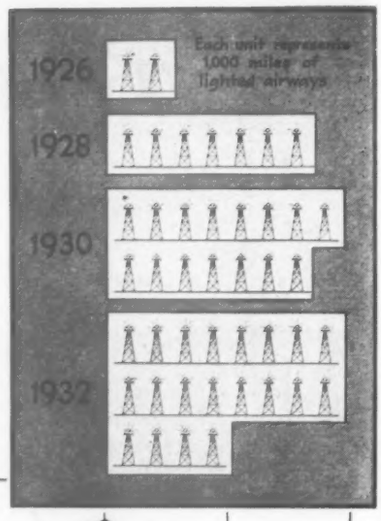


NUMBERS OF MUNICIPAL AND COMMERCIAL AIRPORTS IN OPERATION. Even though many economies have had to be made, and the scale of operations has had to be reduced in many cases, the number of airports available for air traffic has continued to grow. At the end of 1932 it stands at 545 municipal ports and 619 commercially operated, an increase of 233 per cent over the end of 1927.

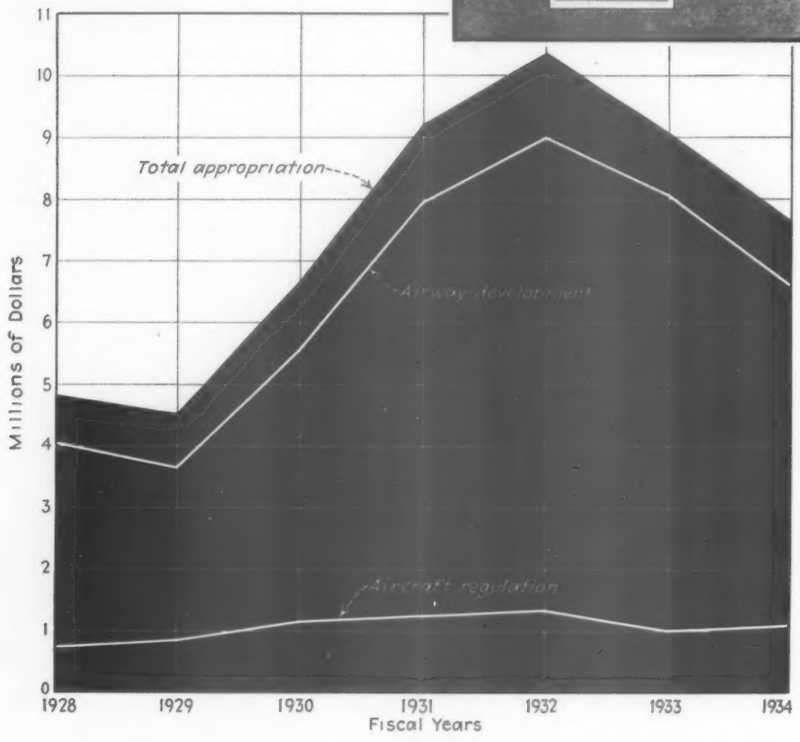
and level area can be a powerful help in time of trouble. The regular airports are supplemented at the present time by 352 intermediate fields along Federal airways, maintained by the Department of Commerce, and 408 marked auxiliary fields. Then too there are a certain number of Army and Navy fields, which are not regularly open to the non-military public but which can be used in emergency.

At first sight the airport position may appear very satisfactory. In some parts of the country it is. A number of the larger cities are admirably provided for, up to a safe margin beyond the level of their present needs. In certain small sections of the country fields are as thickly distributed as safety and the interests of the convenient general use of airplanes demand. Unfortunately, however, such areas are still somewhat exceptional. In thickly-settled parts of the United States there certainly ought to be at least one landing field every twenty miles in every direction, and that requires about one for every 300 sq.mi. of area. In level and thinly-populated territory, of course, a considerably wider spacing is permissible, but to provide a proper coverage there ought to be a total of at least 2,000 real airports and another 3,000 well-marked intermediate and auxiliary fields in the continental United States. The cost of such construction need not be great. Most of the expense of airport work goes into the purchase of land and the provision of the necessarily elaborate installations for the ports attached to large cities. Most such cities are now well cared for, and attention can be devoted to smaller places. There are half a dozen airports in towns of less than 5,000 population for every one that is attached to a city of over 500,000, and there are a dozen that cost less than $25,000 complete for every one of the nationally famous show places that ran into a million dollars or more.

There are at present about 220 fields that serve as stops on transport lines, and about 180 that have five or more commercial airplanes (not counting transport machines) in regular local operation. Private ownership is even more widely distributed.



LIGHTED AIRWAYS. The Department of Commerce has built an airway system up to a present total of 19,500 miles, but work has now been checked, and there is even danger that reduced appropriations may make it necessary to cut down the mileage to below the present level.



FOR THE DEPARTMENT OF COMMERCE, AERONAUTICS BRANCH (1934 figures represent budget estimates). Sharp cuts in the allowance for airway development in the last two years have forced a complete suspension of airway construction work, and leave not even enough money for next year to maintain the existing system. Allowances for aircraft regulation have also been reduced by some 20 per cent from two and three years ago, though there is much more to regulate now than there was then.

ACKNOWLEDGMENT

THE making of any such collection of material as is here presented has, of course, required that we draw upon a great many sources of information. Although the forms of presentation and interpretations have been entirely developed within our own organization, the basic figures have become available through the co-operation of many official and unofficial organizations and groups. Our first and greatest obligation, which it is a particular pleasure to acknowledge, is to the personnel of the Aeronautics Branch of the Department of Commerce. They have been unremitting in their helpfulness.

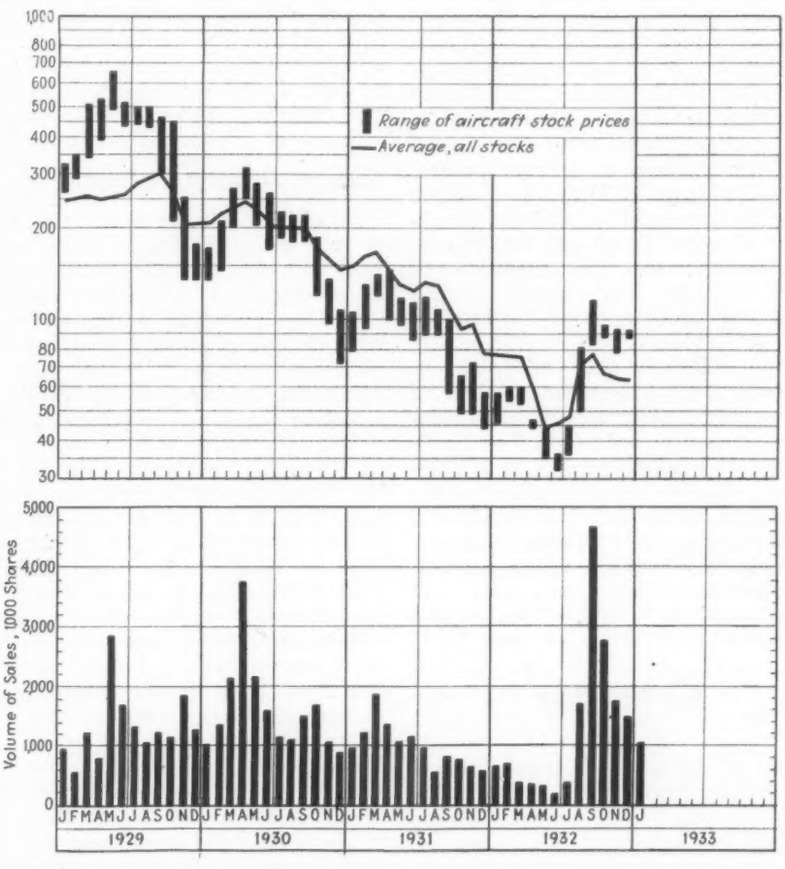
We must express particular gratitude also to the staff of the Aeronautical Chamber of Commerce; to the Post Office Department; to the Departments of War and of the Navy; to the National Advisory Committee for Aeronautics; to many individuals and companies that have responded to questionnaires about their own activities; to the aeronautical division of the Bureau Veritas; and to the officials of a number of European governments, both for their willingness to furnish special material on request and for providing the extraordinarily complete and useful collections of information on aeronautical progress which some of them compile.

Aeronautical securities gain ground

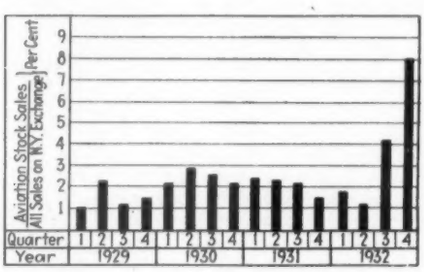
Show belief that aviation will continue to grow

THE stock market plays a much restricted part in human affairs now, as compared with the magnificent role that it seemed to be taking four years ago. Still, however, it furnishes a useful index of what the financial community thinks about the future, and especially of the average of intelligent business judgment of the prospects of the various industries represented on the stock exchanges. Through the first half of last year the aircraft and air transport stocks as a whole were dragging along on the bottom, with very little public interest in their state and with their prices even running behind the average for the rest of the market. In September they had become market leaders. Transactions in aeronatuical stocks were running over 100,000 shares a day, and the average of their prices was running up far above the general average. The relative market position of the aeronautical securities is stronger now than at any other time in the past three years.

Going far beyond the effect of any manipulative campaign in any particular stocks, the reasons for so rapid a reversal of form are plain. The reaction of public feeling after the failure of the absurdly exaggerated anticipations of 1929 reached an end. The financial community has again begun to look at aviation with open eyes and an open mind, and a new confidence in the future of the aircraft industry and of air transportation has resulted. Stocks were bought last fall, and they are being bought now, not on account of their present earnings but on the strength of an assured belief that the growth of aviation will continue, and that aircraft will take a place of steadily growing relative importance in the industrial world.


Range of aircraft stock prices
Average, all stocks
Volume of Sales, 1000 Shares
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J
1929
1930
1931
1932
1933

Range of average prices and volume of sale of aeronautical securities on the New York Stock Exchange. Following three years in which aeronautical stocks declined with, or sometimes even a little more rapidly than, the general level of security prices, they have shown the results of sudden increase in public interest and confidence. During the last six months of 1932 the aircraft index number rose to well above the general level, and the volume of sales reached unprecedented heights. During September the transactions in aircraft and air transport stocks totaled over 4,600,000 shares, more than 50 per cent above the highest figure for any month during the 1929 bull market. The average prices at the end of the year were 150 per cent higher than during June. The financial world's confidence in the importance of aviation's future is plain.



Proportion of sales of aeronautical securities to total sales on the New York Stock Exchange through the last four years. Through the period of the so-called "boom," aeronautical stocks played a very minor part in making up the total record of transactions on the New York exchange. They generally accounted for a little less than 2 per cent of the total sales. Through the first two and one-half years of depression they held almost to that same level. The last half of 1932, with its remarkable revival of public interest in the aviation business and of public confidence in its future, moved the air stocks up into a leading position, with more than three times as great a relative importance in the records of business done on the exchange as they had ever had in the past.

NEWS OF THE MONTH

Misadventures of the air mail

A BONE of contention since the opening of the Lame Duck session, the domestic air mail appropriation after suffering complete annihilation at the hands of the Senate had been restored to its place in the bill. Most articulate defenders of the present system were Senators Bingham, Long and Oddie (from Connecticut, Louisiana and Nevada respectively), more than matched by Senators McKellar (Tennessee), Tydings (Maryland), King (Utah), Robinson (Arkansas), and Glass (Virginia) whose condemnation of the air mail as a "fad and wicked waste of the taxpayer's money" represents the farthest north in Congressional opposition. The Senator from Tennessee had offered an amendment cutting the $19,000,000 appropriation in half, to which the Senate voted an amendment by Senator Metcalf of Rhode Island raising the ante to $16,000,000. Then came the crowning blow, in the form of a motion by Senator Robinson which struck out the domestic air mail section entirely. Subsequent action by the conference committee of the two houses restored the full $19,000,000. Air mail during 1933 will thus operate under practically the same provision as it had during the current fiscal year.

While the Conference Committee battled over next year's appropriation, Congressman Kelly of Pennsylvania, father of the contract air mail system, was engaged in framing a wholly new program for the future of the service. The newest Kelly Bill proposes a method of compensation midway between that now used and that employed before the passage of the Watres Act. It provides for a fixed payment of 0.2 cents per lb.-mile, with a maximum not to exceed 50 cents per airplane-mile. Special payments would be allowed during a five year transitional period, the rate of postage on air mail letters would be fixed at 5 cents for each half-ounce, and post-cards would be carried at 2 cents each. The effect of the bill would be to reduce the outlay for the present air mail system from $19,000,000 a year to about $12,000,000. It would cut the rate on all routes, some as much as 50 per cent.

The Kelly bill resulted from the long-awaited report of the Mead Committee, which was published on Feb. 21. Detailed statistics on air mail accounts, and traffic on individual routes are released by the investigating group, the House Committee on Post Offices and Post Roads under the chairmanship of the Representative from New York.

Suspensions and extensions

Even while Congress talked, several changes in air mail routes which Postmaster General Walter F. Brown has had under consideration for some time went into effect. Four routes—from Phoenix to San Diego, Chicago to Indianapolis, Big Spring, Tex., to San Antonio, and one of the services between Kansas City and St. Louis—were suspended. At the same time several extensions, including the long-awaited direct connection between the east coast and the northwestern states and Canada, were authorized. American Airways and its newly acquired Transamerican system fly the route from Boston via Albany, Buffalo and Detroit to Muskegon, Mich., whence the Kohler line, sub-lessee of that part of the contract, carries the mail across Lake Michigan to Milwaukee. From there the already well-established Northwest Airways completes the trip to Mandan, N. D. An extension of T.&W.A. from Los Angeles to San Francisco also went into effect on Feb. 1.

San Francisco Bay Airdrome at Alameda is no longer the terminus of Transcontinental & Western Air. Under contract signed with the Public Utilities Corporation on Feb. 1 headquarters were transferred to the Municipal Airport at Mills Field.

Anticipating the American Airways opening of operations under the new mail contract, passenger service over the new airway between Boston and Albany is provided by Intercity Air Lines, which has maintained regular three-a-day service between Boston and Springfield for the past nine months. At present the 6-passenger Travelair planes make the one hour and 45 minute run once daily in each direction, with a stop at Springfield, leaving Boston Airport at 8:30 a.m. and returning at 12:20 p.m.

New routes also appear on Canadian Airways' time-tables. A regular air mail service between Great Falls and the mining communities of Bissett and Wadhope in southeastern Manitoba is being flown over a route very similar to one connecting these two cities with Lac-du-Bonnet which was discontinued in 1931. In spite of the withdrawal of a number of Canadian services last year, most of which were in the populous eastern section of the country, the total amount of mail carried by air in 1932 was only just under the 1931 figure, with a total of about 430,000 lb.

Eastern Air buys Ludington

Acquisition of the operating assets of Ludington Airlines by Eastern Air Transport, wholly owned subsidiary of North American Aviation, terminates one of the few ventures in airline operation to have reported a profit without government help. General business conditions, which prevent continued profitable operation even over the densely populated sections served by the company, are responsible for the sale. The Ludington Line, over which some 125,000 passengers have traveled between New York and Washington since its inauguration in the middle of 1930, will continue to be operated independently as the Ludington division of Eastern Air. No changes in schedules or equipment will be made, with the single exception of the suspension of Ludington's Washington-Norfolk run, where present traffic does not justify two services. Eastern Air's future is also involved in the long-pending merger between the North American and General Aviation companies which would establish the latter firm as a holding company with North American stock as its chief asset, but that is not yet an accomplished fact.

New airline equipment

Increases in traffic on Pennsylvania Airlines, serving Cleveland, Akron, Pittsburgh and Washington, have led to the purchase of another Stinson

Calendar

May 28	Deutsch de la Meurthe Cup Race, Paris, France.
June 12-July 10	Soaring Camp, Elmira, N. Y.
July 1-4	Chicago Air Races, Chicago.
July 10-23	Fourth Annual National Soaring Contest, Elmira, N. Y.
September	International Gliding Congress and Meeting, La Banne d'Ordanche (Clermont Ferrand), France.
December	International Rally, Cairo, Egypt.
December 14	Meeting of the Federation Aeronautique Internationale, Cairo, Egypt.

airliner. Equipped with complete blind flying instrument and radio installations, it is the third to be added to the line's fleet in as many months.

First of the fleet of new transport monoplanes being built for United at the Boeing Company's Seattle plant is undergoing flight tests, and is to be placed in service shortly on the San Francisco-Cheyenne division. The new Condor also has taken to the air. First flight tests of the 15-passenger biplane built for Eastern Air Transport at the Curtiss-Wright plant in St. Louis, were successfully passed.

Transportation Committee urges

Air transport fared badly in the Senate, fared much better at the hands of the National Transportation Committee of which the late ex-President Coolidge was chairman. The committee recommended unreservedly for continued government support of air transportation, and especially for continued provision by the Department of Commerce of aids to air navigation. It recommended that the railroads, so far as they might consider that air line competition endangered their prosperity, should get into the air transportation business themselves. The committee's report, prepared after receiving statements from the Aeronautical Chamber of Commerce and from Senator Bingham on behalf of the National Aeronautic Association, and after its examiners had probed the statistical records and visited various witnesses, including the editor of AVIATION, had nothing to say about laying any more regulation on the airlines. It expressed the belief that they should ultimately be self-sustaining, and that in the course of events they naturally would be.

Though the New York, New Haven & Hartford denies having any immediate plans for taking the committee's advice, a bill which would permit it to do so was recently introduced into the Connecticut General Assembly with its sponsorship. Giving the railroads the right to acquire, own, maintain and operate aircraft for the transportation of passengers and freight, it is similar to legislation obtained in Massachusetts last spring.

The Chamber talks things over

The Aeronautical Chamber of Commerce, in annual meeting assembled on Jan. 26, heard reports from its retiring officers and from the chairmen from a dozen sections and committees. High spots in the reports were the record of the 1932 air mail campaign, including the distribution of 3,500,000 air mail stickers and 20,000 posters, and the making of personal contacts with postmasters and business leaders in most of the large cities in the country; an improvement in the attitude of newspapers on accident publicity; a new study of the views of insurance companies on air transport; the holding of discussions with the Army and Navy on military procurement methods; the canceling by the Department of Commerce of a proposed rule limiting the life of approved type certificates to two years; the development of a plan for extending the private market for planes; the formation of a radio and electrical division, and the holding of discussions with the transport operators on radio problems; the expenditure of $5,000,000 on airport work and another $5,000,000 on maintenance during 1932; the development of octane number specifications for standardized aviation fuels; and the making of studies by the Chamber's legal committee of the legal status of airports in residential neighborhoods; of the effect of the American Bar Association's proposed Uniform Aeronautical Code on aircraft operations; and of the possibility of developing an improved form of passenger ticket for general use.

CHAMBER'S NEW HEAD

Thomas A. Morgan, president of Curtiss-Wright Corporation and North American Aviation, succeeds Charles L. Lawrance as president of the Aeronautical Chamber of Commerce.

The treasurer reported income and expenditure for the year each totaling approximately $80,000, and the officers for 1933 formally entered upon their duties. Thomas A. Morgan of Curtiss-Wright is the new president, and the vice-presidents for the various geographic divisions are: George S. Wheat of United, Thomas B. Doe of Eastern Air Transport, James M. Schoonmaker, Jr., of General Aviation, L. B. Manning of Stinson, Richard W. Robbins of T.&W.A., Alfred Frank of National Parks Airways, and Harris M. Hanshue of Western Air Express. C. L. Lawrance is treasurer for the current year, Charles F. Barndt of Great Lakes is secretary, and Luther K. Bell continues as general manager.

Contest plans

Chicago will be host to an air race meeting this summer. Under the management of the Chicago Air Race Corporation which sponsored a similar 1930 event, a four-day meet, which an amendment to the corporation's charter would make an annual event, is planned. The international balloon race for the Gordon Bennett Cup already is scheduled to start there. Twenty Italian seaplanes may be present if their trans-Atlantic flight under the leadership of Gen. Italo Balbo, Chief of the Italian Air Forces, comes off per schedule.

William P. MacCracken, Jr., has been appointed chairman of the Contest Committee of the National Aeronautic Association to succeed Orville Wright.

Plans for the Fourth Annual National Soaring Contest and for a Soaring Camp to precede it, have been announced by the Soaring Society of America. Elmira, N. Y., host to the contest for the fourth consecutive year, also will be the site of the camp, an innovation in this country, but a popular institution in Germany. Primary work in gliding for a period of four weeks, will be conducted by a member of the Soaring Society staff, while the sailplane training will be handled by the Haller School of Soaring. Warren E. Eaton has been re-elected president of the Society, of which Dr. Wolfgang Klemperer will be vice-president and A. L. Lawrence secretary, for the coming year.

What's what among pilots

Wages and hours in air transportation, both in the air and on the ground, have recently been the subject of exhaustive study by the Department of Labor. The results, published in Labor Statistics Bulletin No. 575, indicate first pilots to have had average earnings at the rate of $9,350 a year at the end of 1931, for an average flying time of 80 hours a month. Co-pilots were making an average of $2,700 a year, and flew 170 hours a month to do it. Highest earnings were those of four pilots who made over $950 in one month. Highest flight time went to three pilots who rolled up over 125 hours each in a month.

Average earnings of ground personnel were reported as $31.66 a week. Licensed mechanics averaged $37 a week, mechanics' helpers $22, radio operators $35. All personnel, to the number of some 3,000 on the lines studied, were working full time at the date of the survey. That was a marked contrast to conditions in general manufacturing industry, where it was exceptional to be running over 75 per cent of full time at the same period.

Airline liability convention

The responsibility of airlines to their passengers and to the shippers of goods has just been internationally standardized for a number of countries under the convention of Warsaw, which entered into effect on Feb. 12. Six European countries and Brazil were the first to give full effect to the convention. It provides that the maximum responsibility of an airline for injury or death of a passenger shall be $5,000. Upon packages the maximum allowance is $5 per pound of weight. Any additional value must be covered by insurance if reimbursement for loss is to be secured. The convention further exempts airlines from all responsibility where they can show that reasonable precautions were taken and that no absolute negligence existed. American courts have commonly held American airlines to a materially higher degree of responsibility than the new convention requires.

Another record goes British

After two years patient grooming and waiting for appropriate moonlight over the Sahara, a Fairey monoplane, Napier-engined, left Cranwell Aerodrome near London to set a new world's non-stop distance record. Lack of fuel forced it down 57 hours and 25 minutes later at Walfish Bay, South Africa, 780 miles from the goal, Cape Town, but 327 miles further than the previous record flight, made by Russell Boardman and John Polando from New York to Istanbul in 1931 in a second-hand Bellanca, without benefit of moonlight. The big monoplane, similar to the machine which crashed in the Atlas Mountains in a 1929 London-Cape Town trial, carried more than 1,000 gal. of fuel in its 82-ft. wings. With their 5,341-mile flight, Squadron Leader O. R. Gayford and Flight Lieut. G. E. Nicholetts of the R.A.F. brought the third major world's airplane record to Great Britain, which already holds the laurels for speed and altitude.

Mollison again

At the same time, Captain Mollison was in the air making his sixth record-breaking flight of the last 2½ years. In four hops, and three days and ten hours elapsed time, his tiny four-cylinder Puss Moth flew the 4,800 miles from Lympne, England to Natal, Brazil. The transatlantic flight from Thies, Senegal, on the west coast of Africa, to Natal took about eighteen hours. This is about four hours longer than the time made in January by the French transport plane which is now preparing for its return flight.

It is worth noting that the Couzinet tri-motor trans-Atlantically flown by Mermoz uses American-built B.G. radio-shielded spark plugs. American engines, Wright Whirlwinds, powered Air Commodore Kingsford-Smith's veteran Fokker whose most recent achievement is a 14½-hour flight over the Tasman Sea from Australia to New Zealand in the interest of the air mail routes which it is hoped to establish over that route.

Air transport far afield

The Far East is the scene of new ventures in transport as well as in military aviation. Weekly air mail and passenger service from China to Russia is reported to have been inaugurated when planes operated by the Eurasia Aviation Corporation left Peiping and Shanghai simultaneously on the morning of Dec. 15. Scheduled to meet at Loyang, they continue on single schedule to Lanchow and Tihua on the Russian border. The 3,000-mile trip takes four days, costs $294.

The first Saturday of every month, beginning May 6, 1933, will see the departure of the Graf Zeppelin from Friedrichshafen on its regular Germany-South America service. Rio de Janeiro is the southern terminus and landings are scheduled at Pernambuco and Seville, where the Spanish Government has authorized the construction of a mooring mast. At a rate of $470, about a third higher than minimum first class fare on express steamers, travel time between the continents is cut from twelve to three days.

Malay mutiny

A 100-lb. bomb dropped from a seaplane wrote finish to a strange tale of mutiny on the Dutch battleship De Zeven Provincien in East Indian waters. Protesting against pay cuts, the native crew seized the ship while the commander was ashore at Kotaraja and proceeded towards Surabaya to release comrades imprisoned there. Flying boats brought the show-down. The first bomb dropped on the ship was a direct hit with deadly effect. When it tore away the bridge, killing eighteen men and starting a fire, the crew took to boats and surrendered.

Navy plays war

Airplanes put the sting in the Black fleet streaking through Pacific waters from Hawaiian victories to attack the West Coast in Problem 14, the 1933 naval war game. Its 23 ships, including two aircraft carriers, the fastest in the service, were much inferior in sheer tonnage to the Blue defending forces. However, the 113 vessels stretched along the coast from Puget Sound to San Diego were unable to restrain the 175 planes of the Black fleet from successful raids on both San Pedro and San Francisco. While 60 Black planes from the Saratoga laid waste San Francisco's waterfront and navy yard, the carrier itself and its 21 remaining aircraft were demolished by the Blue forces by way of retribution. No score was rendered officially. Replacement of obsolete vessels, more small carriers like the Ranger now under construction, and planes of longer range were outstanding needs seen by naval officers as a result of the games.

Aeronautics would bear the brunt

Asked to indicate the effect on the Navy of the 5 per cent reduction which would be applied to all departmental appropriations under an amendment to an appropriation bill adopted by the Senate, Secretary Adams produced an alarming schedule in which aviation was threatened with particularly bad treatment. The 5 per cent cut in the Navy's bill would, the secretary said, require a complete laying-up of the Langley and either the Lexington or Saratoga, and either a decommissioning of the Akron or a failure to commission the Macon. Aircraft carrier and rigid airship strength would both be reduced 50 per

AMERICAN ENGINES FOR GERMAN FLYING BOATS

Two 650-hp. Curtiss Conquerors power the Dornier Wal flying boats being built for operation on the Scadta lines in Colombia and Venezuela.

HORNETS IN SWEDEN

Latest addition to the fleet of Swedish Aerotransport, to link Stockholm with Helsingfors (Finland) in summer and Malmo with Paris and London during the winter, is a twelve-passenger Swedish-built Junkers powered with three Pratt & Whitney Hornet engines. Its top speed of 143 m.p.h. as seaplane is unequalled by other European transports of this type.

cent. No other class of combatant naval vessels would, according to the Secretary's plan, undergo so large a relative loss.

As passed by the House, after a debate of record-making brevity (five hours), the Naval Appropriation bill allots $21,957,459 to the Bureau of Aeronautics, some four and a half million below the figure for the current fiscal year and $863,821 less than the budget estimates. Appropriation for maintenance of aviation activities is up about $700,000 while provision for new aircraft is $400,000 below the current year's figure. A proposal to cut the flying pay to officers in the higher grades was stricken from the bill early in the debate.

Amendment to the Reconstruction Finance Corporation act specifically provides for loans for the construction of aircraft suitable for overseas transport and for port facilities essential to their use.

Announcing the Macon

On March 11 the Macon, twin sister of the Akron, will be air-borne within the hangar for the first time, at the plant of the Goodyear Zeppelin Corporation. Two weeks after the launching and christening ceremonies flight trials are scheduled to begin, upon the conclusion of which the new airship will proceed to the Pacific Coast to be based at the Naval Air Station at Sunnyvale, Cal. Essentially the duplicate of her sister-ship, the Macon, officially designated ZRS-5, incorporates a number of minor improvements.

The propriety of helium production by the Bureau of Mines, a lively issue of four years ago, was brought to life again by the report of the Shannon Committee of the House of Representatives, investigating government competition with private business. The Bureau of Mines, extremely hostile to the only important private producer of helium, has practically driven private industry from the field. The Shannon Committee recommended that it be brought back, and that a part of the Army and Navy helium requirements should be definitely allocated to private sources in order to rebuild the industry.

No unified Air Corps

While the joint committee of the War and Navy Departments set up to study possible phases of service overlapping has weighed the project for a separate unified Air Corps and found it wanting, it does recommend closer co-operation and co-ordination between the two air services now existing. The committee recommends further study of the practicability of joint use of depot and maintenance facilities, as well as of air fields. A unified Air Corps would further complicate co-ordinated administration, decrease the efficiency of the forces, and increase their cost.

A Freshman class of 175 began training at the Air Corps Primary Flying School, Randolph Field, Tex., on March 1. Six army officers, sixteen enlisted men and 143 civilians are working there for the rating of airplane pilot. At the end of the year's course civilian and enlisted students receive in addition a commission of second lieutenant in the Air Reserve, and may be placed on extended active duty with Air Corps units.

Fast bombers for the Air Corps

New flying equipment for the Air Corps and National Guard has been contracted for by the War Department to the tune of almost $4,000,000. Largest order goes to the Glenn L. Martin Company of Baltimore, Md., which is to supply 38 bombardment planes. Totaling $2,070,890, the order covers three closely-related models designated as YB-10, YB-12, and YB-13. All are mid-wing monoplanes, each powered with two radial air-cooled engines of about 550 hp. Though performance figures have been withheld, they are reported to be capable of giving the fastest pursuit planes a run for their money, even with a 2,000 lb. load of bombs. High-speed companions of the new bombers are the new Boeing P-26 Pursuits, 111 of which are included in another contract. A single seater low-wing monoplane with Pratt & Whitney Wasp engine supercharged to about 525 hp., the P-26 is essentially identical with the plane which under the experimental designation XP-936 has been undergoing extensive service tests. With engineering data and spare parts, this order totals $1,201,117, only $10,800 per plane. Contract for ten single-engined cargo transports, Type P-27A, has been awarded to Bellanca Aircraft of New Castle, Del. Similar to their commercial prototype, the Airbus, the transports with their complement of spares will cost $275,651.

Militia Bureau Funds provide for the purchase of fifteen O-38E observation planes from Douglas Aircraft Company for use by the National Guard. Refinements of the well-known Douglas O-38B with better streamlining about the engines and with pilots' and observers' cockpits enclosed, these planes are priced at $174,614. Twenty-eight Pratt & Whitney Hornet engines with spare parts have been contracted for at an additional cost of $154,729.

Joint "shotweld" research

Two companies which for a number of years have been investigating the "shotweld" system of aircraft construction independently of each other have arranged to carry on further developments jointly. Under the leadership of Colonel Ragsdale, the Edward G. Budd Manufacturing Company has been engaged in laboratory work in this method of stainless steel construction. Carl de Ganahl and his associates in Fleetwings, Inc., of Garden City, N. Y., have been carrying on along similar lines. To prevent duplication of costly experimental research and therefore extend its scope, rights to use the process covered by applications and patents are being cross-licensed from one company to the other, as is the right to sublicense the system to the aircraft industry. Savoia in Italy and Potez in France already use the "shotweld" system under license from Budd.

Granville reorganizes

Designers and builders of the world's landplane speed record holder, the Granville Brothers have reorganized to enter the commercial airplane field. Alfred D. Chandler and William B. Hurlburt are respectively secretary-treasurer and vice-president of the new organization. Among the founders of Bellanca Aircraft Corporation and its treasurer until his resignation a few weeks ago, Chandler is also president of Island Airways, connecting New Bedford with Cape Cod, Nantucket and Martha's Vineyard. Hurlburt until

a few months ago was executive vice-president of the Bellanca company. Z. D. Granville heads the new Granville Aircraft Corporation, whose immediate plans have not yet been announced.

Another new name on the roster of airplane manufacturers is the Security-National Aircraft Corporation. W. B. Kinner has resigned as director and consulting engineer of the Kinner Airplane & Motor Corporation to organize the new company, which has taken over the erstwhile Emsco Aircraft plant in Downey, Cal. First product of the company is to be a 2-passenger sport-plane with 100-hp. engine, priced within reach of the average pocket-book. Free instruction to all purchasers who desire it is a feature of the company's new system of airplane merchandising.

All manufacturing and business assets of the Sky Specialties Corporation of Detroit, Mich., manufacturers of Heywood injection starters, have been sold to the Eclipse Aviation Corporation of East Orange, N. J., a division of Bendix Aviation. Sale and servicing of the Heywood starters, as well as their manufacture and further development, will be handled from the East Orange plant.

Brazil buys Wacos

Following the course which made it the best customer of American aircraft and engine manufacturers in 1932, Brazil last month placed an order with the Waco Aircraft Company for ten advanced trainers, powered with Wright 240-E Whirlwind engines, for its air service. Since the first shipment in mid-March, 1932, 69 Wacos have gone South for use in the Brazilian services.

An unnamed South American republic is the destination of twenty 160-hp. Kinner engines, ten of which are already on their way. Ten Kinner engines also for military use were recently shipped to the Orient. This military-type engine, for use not only in training ships and light bombing planes but also in light attack planes equipped with machine guns, is a new field for the Kinner company.

Fired with patriotic zeal by events in the Far East, the Chinese Aviation Association has been formed in New York to arrange for the training of its members as pilots. Forty young Chinese of the membership plan to learn to fly. Twelve are now actually learning at Floyd Bennett Field, New York, on an Aeromarine-Klemm plane.

A novice in air transport

Serving as air ferry between the various units of Florida Year-Round Clubs at Miami is the first of the new Pitcairn cabin autogiros to go into commercial operation. Powered with a 420-hp. Wright Whirlwind engine, it seats a pilot and four passengers, has a top speed of about 120 m.p.h. A tilting pylon by which the pilot can change the angle of incidence of the rotor and a controllable pitch propeller are unusual features of the plane.

A British firm plans to go us one better with an autogiro under construction for the Air Ministry. A 500-hp. Panther engine is estimated to give a top speed of 160 m.p.h. and a cruising speed of about 130.

Memories of the super-light planes which flourished in Great Britain in 1923 are revived by an epidemic of "planettes" there. Developed by glider enthusiasts, the new machines have motorcycle engines rated at 6 hp. and extremely light wing loadings. Costing but little, they have been used successfully for giving training to novices, and for holding spectacular competitions around short race-courses.

German transport planes

Transport as well as military production is keeping European factories busy. Junkers is working on fourteen planes for Deutsche Luft Hansa. Ten are tri-engined metal passenger planes of the type Ju 52, powered with engines of American design ordered from the Bavarian Engine Works at Munich. Four mail and freight planes complete the $475,000 order. High-speed transport planes planned to cruise about 150 miles per hour have been completed recently by both the Junkers and Heinkel companies for experimental use on German airlines. Single-engined low-wing monoplanes with retractable landing gear and built to accommodate five to six passengers, the new machines are awaiting tests by the German Aeronautical Research Institute.

The Fiat plant at Turin, Italy, is busy completing a $420,000 order for twenty biplane bombers with 1,000 hp. Fiat engines, six of which have already been delivered to the Chinese Government at Shanghai. An Italian pilot and mechanic accompanied the machines, which are fully equipped with bomb-racks, wireless, and machine guns, to train Chinese pilots and personnel in handling the bombers.

A new British engine

Work at the Royal Aircraft establishment at Farnborough, England, has resulted in a heavy-oil airplane engine, an adaptation of the Rolls-Royce Condor, which recently passed a 60-hour Air Ministry type test, and has been installed in a Hawker Horsley torpedo bomber for flight tests. Weighing 1,500 lb. and of water-cooled V type, it is the first British diesel actually to be used in an airplane. It yields 500 hp., as compared with the 650 hp. output of the Condor in its original form. With a compression ratio of 12½ to 1, its maximum number of revolutions per minute is 2,000 and cylinder pressure 800 lb. to the square inch. Slightly longer and higher than the original gasoline engine, it is the same width and can easily be fitted into similar airplanes. The Bristol company has also been engaged on a diesel design, in that case an air-cooled radial.

Corporation news

First financial report received for 1932 comes from the Irving Air Chute Company, in black ink. Net profit after taxes and other charges was $162,796, or 77 cents on each of 211,000 no par capital shares outstanding (including 15,000 in the company's treasury). Each share earned 87 cents in the preceding year, when total profits were $184,046.

Though the report of National Aviation Corporation for 1932 showed an apparent income loss during the year, due to losses having been taken by the sale of securities which had previously been carried on the books at their cost price, there was a very substantial real improvement in the position of the corporation. The net value of the corporation's assets at the end of 1932, including its investment in Washington Airport, was $10.49 a share, as against $7.20 per share a year earlier. Excluding all real estate and other properties of questionable or uncertain momentary value, the corporation owned marketable stocks having a current market value at the end of the year of $2,978,000, or $7.83 per share.

Personnel

W. Laurence LePage, vice-president and chief engineer of the Kellett Autogiro Corporation has resigned to undertake independent work in the field. With the co-operation of the Autogiro Company of America, whose experimental facilities are at his disposal, Mr. LePage will devote his time to the design of large transport autogiros.

Several changes in the personnel of the Eastern division of American Airways resulted from its recent consolidation with Transamerican Airlines. J. L. Ruden, who was vice-president in charge of operations for Transamerican is now superintendent of maintenance on the Eastern division with headquarters at Cleveland. C. A. Rheinstrom, Transamerican's general traffic manager, is stationed at Robertson, Mo., as division traffic manager. E. F. Ward has been transferred from American's Southern division to head all operations of the Eastern division as general superintendent.

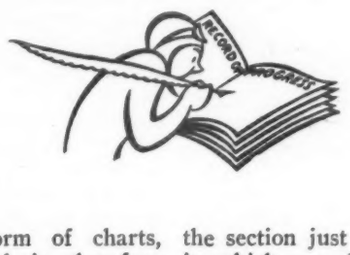
Major Georges Thenault, Air Attaché of the French Embassy for over ten years, has been recalled to France for duty in the aviation service. As captain, he commanded the Lafayette Escadrille in the World War.

SIDE SLIPS

By Robert R. Osborn

Record of progress

IN the rest of this issue there are many charts, curves and tables which give one an accurate picture of the progress made by "this airplane business" in the very few years it has been with us. This progress is amazing even to those of us who are in the business, as we have quickly come to accept the improvements as necessities and commonplaces, and it is surprising to think what a short time ago it was that we had to do without them .



In looking over the data presented in this issue we have come to the realization that there has been some progress in the art which is not susceptible to presentation in the form of charts, curves and tables, and is therefore likely to be overlooked. Nevertheless it is a real part of the progress which has been made, and so we have decided to devote our usual space in this issue to these items. In the first reading they may not seem important to one, but we say in all seriousness that the facts below are as truly indicative of the amazing progress made in aeronautics, as any which could be presented.

Baling wire, fence wire and fence rails have almost passed out of use as materials for aircraft construction. In the "early days" baling wire rigging and fence-rail interplane struts were standard equipment for the aviator who had to put his ship together in the spring, and found himself short of funds (as they all did). Later these materials came into use only as repair equipment for the barnstorming pilot after his crack-ups. Just moderate repairs to a "Jennie" would make a farmer's fence look as if a stampede had run through it. The introduction of high-tensile steel streamline wires and metal interplane struts were severe blows to the baling wire and fence rail industries, but perhaps it was all for the best.

The day has fortunately passed when the effectiveness of the airplane as a war machine had to be proven to Congressmen by means of mimic warfare demonstrations. The fact that the dynamite hidden in the old buildings, used as targets, used to go off before the bombs had actually fallen into them, never seemed to bother the old-time Congressmen. The funds thus obtained by simple and harmless deception, have been a good investment. Fortunately the modern Congressman doesn't have to be fooled, for we doubt if he could be. He could probably discourse intelligently on the performance and characteristics of the airplane doing the bombing and the degree of effectiveness of the bomb which was being used.

News of airplane accidents very seldom rates the front page any more,—if mentioned at all the news appears in the section just ahead of the want ads in which are also listed the names of people who have been wrapping automobiles around telephone poles or disputing the right-of-way with taxicabs. Good aviation news very seldom makes the front page any more either,—it generally tops the list on the financial page. Both changes are decided improvements.

Also, so far as the newspapers are concerned, a pilot is no longer "an intrepid aviator," and a forced landing is no longer a "2,000-ft. dive, and miraculous escape from death."

The airplane having been proven to be a totally inadequate machine for "promoting amity between nations," very few aviators are flying them from one place to another for that announced purpose.

Seven thousand pilots have discovered, to their amazement, that airplanes can be flown while one is wearing ordinary business clothes, and without the aid of helmet, goggles, leather coat, whipcord breeches, and leather riding boots.

The youth who staggers through several solo hours in the hope of becoming a tea-time hero and super-man, is amazed to learn that the young lady to whom he is talking has logged 1,200 hours and that the hostess has a transport license.

The man who used to call up the police station to complain about the pilot who nearly knocked over his chimney, scared all of his chickens so that they won't lay, and is likely to fall through the roof at any time, now sets his clocks by the mail plane when it passes over his house each evening.

The businessman who vowed he'd never ride in one of those things until they arranged it so that he could keep one foot on the ground, now dozes comfortably in the reclining chair of a transport plane as it makes its way across the continent.

The first Roosevelt showed that an airplane was an acceptable means of transportation for a president,—the second Roosevelt showed that the airplane was the best means of transportation available for anyone.

The old-time exhibition pilot who would refuse to fly if the breeze would rustle a silk handkerchief held overhead, has a son who flies the mail 800 miles and lands it on time at its destination, having been able to see the ground only when he came down through the fog to make his regular landings.

The early presidents of our airplane companies had to be rather good hands at carpentry, engine overhaul, metal-working, and swinging dope brushes. The present presidents do most of their work with the financial "dope sheets."

Not so very long ago, the opening sentences of the discussion in some patent applications used to be "Whereas it would be a great boon to mankind if human beings were able to soar through the air like birds——." Now they read, "In the process of the great researches toward improving the efficiency and performance of aircraft——."

The airplane manufacturer used to adapt automobile engines to make up his power plants. The present day automobile manufacturer adapts airplane fuselages to make up his bodies.

The seller of tickets for airplane rides is no longer the leather-lunged circus barker exhorting the crowds in the open fields along the country roads, but the soft voiced, and beautiful of course, young lady seated at the mohogany desk in the lobby of the airline terminal.

On the other hand, our mechanics, God bless them, are as hard-boiled, overworked, grease-covered, and efficient as they have always been. The newer generations can improve our practices and cast aside our best traditions as they will, but we warn them that we shall tolerate no tinkering with our one instituiton which has remained unchanged since the good old days,—the aviation mechanic.

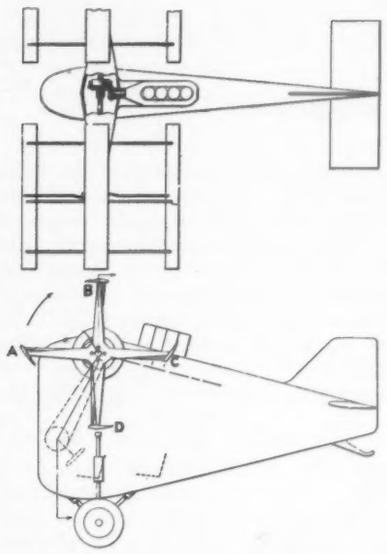
FLYING EQUIPMENT

Sidewheel aviation

THE stage is set for the Aeronautical Fancies of 1933. First skit on the program, produced with the new year barely two weeks old, presents a new type of rotor aircraft. When Dr. Adolf Rohrbach, well-known builder of all-metal flying boats, chose the Berlin correspondent of a New York paper to be the first recipient of an interview and a popular explanation of Dr. Rohrbach's new rotor-craft he stirred up a hornet's nest. He created a popular excitement that has scarcely been equalled in aeronautics since the great days of trans-oceanic flying. The interest shown by the press, and the amount of space that was devoted to following the new machine up in the next few days, were in marked contrast to the virtual silence that greeted the report of de la Cierva's first autogiro successes of eight or nine years ago. They may be taken as evidence of a really intense and growing popular interest in anything that promises to simplify flying, and to bring aviation for every man within the realm of practical possibility.

But a couple of points were overlooked in many of the stories that were written. It was often overlooked that the paddle-wheel rotor type of aircraft with its anticipated ability to travel in any direction, vertically or horizontally, and at any speed from zero up, is as yet thoroughly experimental, and that no such machine has as yet actually been flown. The type seems to have excellent possibilities, and it deserves the closest scrutiny and the most sympathetic observation, but the record of actual accomplishment is yet to be written. Another thing generally overlooked, and in fact generally unknown, is that a paddle-wheel rotor design has been under intensive development in the United States for the past six years, and has reached the point where actual construction can be started at any moment. The American inventor who has written a long record of patient theoretical investigation, trial design and analysis, and wind-tunnel experiment, is a Philadelphian. His name is Haviland H. Platt, chief engineer of the Wilkening Piston Ring Company.

The scheme of using paddle-wheels with feathering or oscillating blades for aircraft sustenation and propulsion (or both) goes back much more than six years. The patent office is full of schemes of that category. Some of them have been tried in a small way and found unworkable, while in other instances the unworkability was quite obvious without



The Platt sidewheeler as shown in Patent Office drawings.

the necessity of trial. Many of our readers will recall at least one design, the Kirsten-Boeing, developed by Professor Kirsten of the University of Washington. It reached the point of rather extended practical experiment about 1925, but it was finally laid aside, at least for the time being. The Kirsten device was intended more as a propeller than as a means of providing lift, but it could have been employed in either connection. At about the time that Professor Kirsten's experiments were checked, Mr. Platt's started.

Enough of generalization and historical background. Now let us concentrate on the Platt design, as developed into its finished form through wind-tunnel experiments first undertaken at the Massachusetts Institute of Technology in 1927 through arrangement by the present editor of AVIATION, then Assistant Secretary of the Navy for Aeronautics, and subsequently at New York University.

The Platt machine is shown diagrammatically, simplified to the limit to bring out the most essential elements of the mechanism, in the figure reproduced in this article. On either side of the fuselage is a rotating spider driven directly by the engine and carrying four (or possibly more or less) oscillating blades. Each blade is pivoted near its center of pressure to a fixed arm of the spider, and has its angle controlled by a link attached near the leading edge of the blade. The controlling links are connected to a strap passing around an eccentric, exactly like the valve rod running from the eccentric on the simplest type of steam engine valve gear, so that as the spider rotates each control rod is wobbled in and out regularly. Each blade is then oscillated, during a complete revolution from a certain positive angle to an equal negative angle and back again, all angles being measured relatively to the tangent to the circle in which the blades are traveling.

To make this clear, consult the diagram of the profile of the machine. In that case the top and bottom blades are pointed exactly along the tangent of the circle, being in the neutral position in the middle of the oscillation. The blade which is on the forward-pointing arm is pointed outward from the tangent at the maximum positive angle of its oscillation, and the blade on the backward-pointing arm has its leading edge pointed inward at the maximum negative angle. In this case the range of oscillation appears to have been about 30 deg. either way from neutral.

Blades operating like those shown in the profile would obviously have a positive lift, or one acting radially outward, on the blade marked A, a negative lift, or one acting inward toward the center of the spider, on the blade C, and practically no lift and only a little drag on blades B and D. The last two would counterbalance each other, and the positive lift on A and the negative lift on C would both act forward and combine to give a driving or propelling force. With the blades set as shown in the figure, in other words, there would be no lift as the rotor turned, but only a pure propulsion.

At this point, however, the control enters. It is too early to go into full mechanical detail on the control to be used, but in principle it depends simply upon the variation of the position of the eccentric which controls the links to the blades and the amount of the throw of that eccentric. With the eccentric in a certain position the condition shown in the sketch obtains, so that there is a pure propelling force. With the eccentric turned 90 deg. from the indicated setting the blades would have no lift when the arms to which they were attached were in the horizontal position. With the arms vertical, either pointing upward or pointing downward, the corresponding blades would carry an upwardly-directed force, exactly as the blades A and C carried a forwardly-directed force in the case covered by the sketch. In that instance, therefore, there would be pure lift and no propulsion. By throwing the eccentric to various intermediate positions, and to other positions throughout the entire circle, it is possible to get any desired

combination of horizontal and vertical forces—up, down, forwards, or backwards. With the eccentric properly set, too, when the machine starts to descend under the action of gravity after a motor failure the whole spider and the blades that it carries will auto-rotate, the rotor as a whole will continue to develop a lift, and the rate of vertical descent can be kept down to properly low figures. The type can, at least theoretically and so far as model experiments have been able to determine, rise vertically, descend vertically, hover motionless, and travel either forward or backward on either a horizontal or inclined path. The possibility of getting a negative propelling force can of course be used to apply the brakes and to pass quickly from travel at a high rate of forward speed to the hovering condition in case of collision danger.

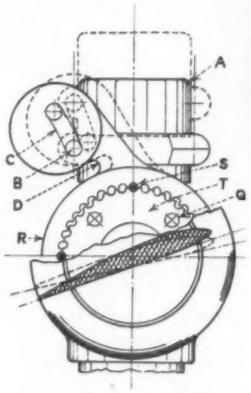
The control problems of a new type of aircraft are never fully studied, because they are never fully known until the machine has been built. Everything that could be said about control or stability would seem so speculative, prior to construction and flight trial, that space will be allowed only to record that the lateral and directional control operate exactly like the control of the course followed. To roll the machine the throw of the eccentric will be increased on one side and decreased on the other, so that the lift of one rotor will go up and that of the other will drop. To turn, both the throw and the angle of eccentricity will be differentially varied, so that there will be a larger component of thrust on one rotor than on the other, and the craft will be dragged around accordingly.

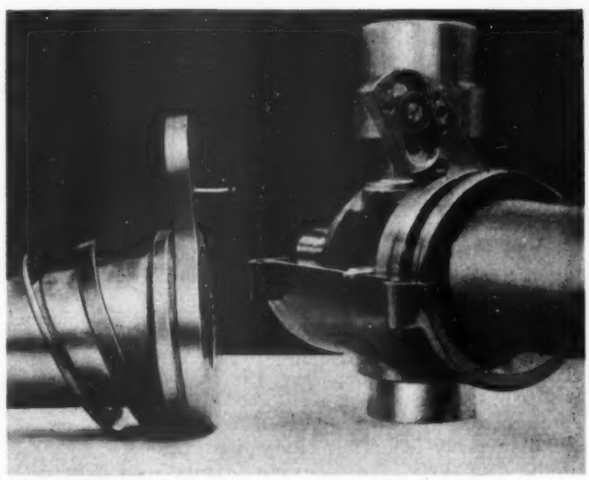
A new propeller by Hamilton Standard

INTEREST in the controllable pitch propeller dates back a good many years (as early as 1918-19 the Army Air Corps conducted flight tests on propellers whose pitch was not only controllable in flight, but was reversible; object—to shorten ground run after landing), but the active application to commercial types is only now getting well under way. Mechanical difficulties acted as a potent retarding factor to early post-War development, but at least three practical types are now on the market.

Hamilton Standard, propeller manufacturing unit of United's manifold activities, has long been interested in the problem, and has lately made announcement of a revised and simplified form of its earlier hydraulic and centrifugally-operated controllable airscrew. As before, it is of the two-pitch type, that is, it operates at two pitch positions only, *low* for takeoff and climb, and *high* for maximum flight efficiency. Intermediate pitch positions cannot be maintained in flight, but for commercial purposes it is argued that there is little to be gained from intermediate pitches, as maximum efficiencies at takeoff and at cruising speed are all that are desired. There has been some discussion of the desirability of a third, or maximum-speed, pitch setting (*S.A.E. Journal*, March, 1932), but it is felt by the manufacturers that the results attained would be scarcely worth the necessary increase in weight and complication.

The operating element of the Hamilton Standard propeller is a small hydraulic cylinder (A) mounted on the hub in line with the propeller shaft axis. The piston element is fixed to the hub. The cylinder portion is free to slide in or out along the shaft axis. Operating fluid is obtained by bleeding oil from the high-pressure side of the engine lubricating system. A small three-way valve is mounted in the nose-piece of the engine crankcase (a feature now incorporated in production models of P&W Hornet and Wasp engines). With the valve on the pressure side the high-pressure oil is introduced into the center of the hollow propeller shaft, and thence directly into the operating cylinder. Shifting the valve to the "drain" position permits oil to flow back from the cylinder through the propeller shaft and into the engine oil sump. Leather packings prevent a leakage of oil out of the cylinder. Wear on the packing is almost negligible due to the slow and infrequent operation of the mechanism.





Left: Sketch showing twisting action on blades from fore-and-aft motion of operating cylinder (A) through pins (B) working in cam slots (C). Note vernier adjustment between blade end and lever arm ring (R). Solid lines show high-pitch position, dotted lines the low. View is along blade axis toward the hub. Above: View of disassembled parts of mechanism. Note method of retaining blades in hub. Thrust bearing race rings are in place, but roller cage has been removed from the blade at left.

Attached to the cylinder, one on each side, are two studs or pins (B) which carry ball bearing rollers which engage in cam-shaped slots (C) in lever arms (D) attached to the propeller blade ends. The slots are so shaped that a fore-and-aft motion of the cylinder causes a rotation of each blade about its long axis. When the cylinder is at the inner limit of its travel, the blades are in the high-pitch position. Forcing the cylinder outward under the action of the oil pressure twists the blades to the low-pitch position. Counter-weights attached to the lever arms tend to keep the blades in the high-pitch position at all times. Thus when the valve is on the "drain" position, or should the oil pressure fail for any reason, the blades automatically assume the high-pitch position. The action of the cams in twisting the blades is indicated in the sketch.

Once a mechanism has been worked out to provide angular displacement of the blades from some simple controllable fore-and-aft motion in the hub, three conditions must be satisfied before a practical propeller results: (1) blade ends must be designed for adequate strength and so mounted so that they may be easily rotated about their axes under the action of high centrifugal loads; (2) it must be possible to vary the controllable pitch range by providing means of adjusting the absolute relationship between hub and blades (not in flight), and (3) adjustable stops must be provided to limit the maximum and minimum pitch setting.

The blade-end construction and the blade-retaining mechanism are shown in the accompanying photograph. Blades are hollow bored for a considerable portion of their length for lightness and for efficient resistance to bending stresses. They are provided with long tapered bushings (T) which fit over machined spindles forged integral with the hub. The centrifugal forces are ultimately absorbed in the forged steel hub barrel through roller-thrust bearings of large

capacity. The barrel is split in two halves and is clamped together by four bolts. Alemite fittings are provided on the hub to permit lubrication of the internal working parts. The hollow-blade ends are plugged off just beyond the ends of the tapered spindles to prevent oil and grease escaping into the hollow portion of the blades.

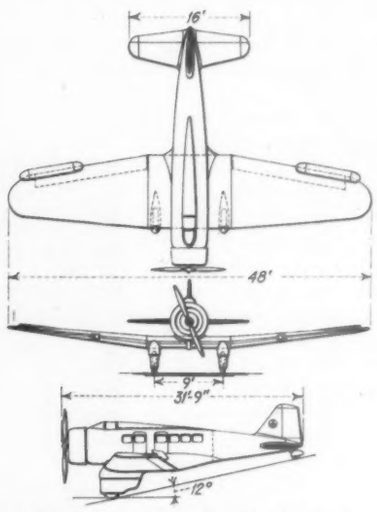
The blade shifting lever arm and counter-weight bracket (D) is an integral part of a ring (R) which fits around the outside of the blade-end bushing. The inside of the ring is provided with 40 semi-circular holes, and the outside rim of the blade bushing (T) has 36 semi-circular holes, as shown in the sketch. Four indexing pins (S) are provided at each blade end, to couple the ring to the bushing. As the four locking pins are located 90 deg. apart it is possible to index the counter-weight brackets relative to the blades in steps of 1 deg. by removing the pins, shifting the bracket ring the desired number of notches, and reinserting the pins. When the propeller is assembled the removable pins are held in place between the blade butt and a machined ring on the hub spider, and therefore cannot come out. This method of indexing the blades with respect to the brackets gives the second of the adjustments mentioned above. The third, the restriction in the range of pitch travel, is taken care of by means of stop-nuts set into the counter-weights parallel to the operating cam-slots (C), so that the pins carrying the roller attached to the operating cylinder strike the nuts before the limit of the cam-slot is reached. The stop-nuts are mounted on a rod fitted with right and left-hand threads, and rotation of the rod moves the nuts simultaneously in or out along the axis of the cam-slot. The indexing feature, together with the adjustment of the counter-weight stop-nuts permits the selection of any desired high and low-pitch blade angles not more than 6 deg. apart. If more than 6 deg. of adjustment is required special parts must be furnished.

The external portion of the new propeller's hub is shorter than that of present types of metal propeller, and therefore permits the use of a very small spinner to cover the whole mechanism. Where a spinner attachment is desired, special bolts are provided in place of the standard hub clamping bolts.

"Sky Chief" goes commercial

HARD on the heels of Northrop's announcement of two special-purpose airplanes for Antarctic Explorer Ellsworth and Texaco's Researcher, Frank Hawks (AVIATION, January, 1933, page 25) comes the word of Transcontinental & Western Air's acquisition of fifteen high-speed transport ships of the same general design. Again, for identification, the Greeks had a word for it, for the new machine is "Delta" of the Northrop series.

Although similar in general outline to the Hawks-Ellsworth Gammas, certain modifications were obviously in order to adapt the design to the requirements of commercial service. Northrop's present practice of locating the pilot in an open cockpit aft of the mail and passenger compartments (typical of the "Alphas") has been abandoned in favor of a fully-enclosed compartment high up in the fuselage just behind the fire-wall. This appears to be a definite step forward in the field of safety, for it has always appeared somewhat illogical to impose upon the pilot of a passenger transport the handicap of almost total "blindness" downward and forward when his ship is in its most critical attitude—the landing position. With the new cockpit location, the range of vision in the essential fields should be materially improved.



Three-view drawing of the new "Delta" by Northrop.

The cabin layout may be varied to suit the requirements of the service. A fuselage diameter of 58 in. permits a variety of seating arrangements and cargo accommodations. Allowing for fuel and oil for 600 miles at 180 miles an hour cruising speed, complete radio and miscellaneous equipment, and weight of one pilot, the net payload is 1,805 lb. The ship shows a relatively high ratio of disposable load to gross weight, the figures being 3,250 lb. and 7,000 lb. respectively, yielding a weight empty of 3,750 lb. Redesigning certain structural elements and making full use of a new aluminum-alloy (24 SRT Alclad) the new machine, although similar in general design to the Alpha, has over 100 per cent larger payload capacity and considerably greater performance for a given horsepower. The gross load has been increased almost 45 per cent with but a slight increase in empty weight.

The engine selected for the Delta is the Wright Cyclone 1,820 F. supercharged to 600 hp. at 8,000 ft. altitude. It will be recalled that Hawks' "Sky Chief" made use of the newly-developed 14-cylinder Wright Whirlwind, and the Ellsworth plane was fitted with a D1 Wasp by Pratt & Whitney. The engine mounting has been well worked out for cleanness and simplicity. In line with modern practice which makes excessive propeller and engine vibration intolerable, the welded steel mounting structure is insulated from the forward bulkhead by heavy rubber bushings. Full N.A.C.A. cowling is provided. All cowling sections are manufactured to close limits on jigs for ready removal and replacement. Quick-acting fasteners permit rapid removal of any panels without disturbing adjacent sections, an important feature from the standpoint of engine servicing. Inspection doors are plentiful throughout.

It has become almost axiomatic that a ship intended for transport use must be studied carefully in the specification and design stages for ways and means of reducing maintenance expense. Transcontinental & Western Air, with many months actual flying experience with the Alphas (see AVIATION, September, 1932, page 378), has not overlooked these matters, and has included in the specifications, in addition to the cowling details mentioned above, such features as fully enclosed ball bearings on all controls and over-size removable bushings at all points of wear and tear. The insulated engine mount is quickly removable from the fuselage by uncoupling four large bolts.

The combination of trailing-edge flap and independently mounted aileron of the Gammas has been retained for the transport. The consequent marked increase in speed range and steepening of the gliding angle increases the safety of the ship by a considerable margin. It becomes possible to get into and out of restricted fields under emergency conditions with considerably less risk than usually attends such maneuvers.

Although retracting landing gears appear to be the rule on 200-mile-an-hour 1933 transports (AVIATION, February, 1933), Northrop again expresses his belief in the ultimate economy of the fully enclosed fixed-wheel design in the new machine. The argument that the cost of the slight increase in overall drag is more than offset by the saving in weight, and the simplification in structure certainly deserves a hearing. To offset the old and sometimes valid argument that wheel pants add appreciably to the cost of maintaining wheels, tires, and brakes, the method of support and attachment of the Delta fairings has been given unusually careful attention with an eye toward rapid and easy removal and reinstallation.

AIRCRAFT AT WORK

Wings of Mercy over Oklahoma

OUT in the country around Mangum, Okla., the clanging bell and shrieking siren of the ambulance has given place to the roar of an airplane engine. The Border-McGregor Hospital of that city may be the prototype of the hospital of the future for it is equipped with complete landing field and hangar facilities. Dr. G. Fowler Border, chief surgeon, has been averaging better than 1,000 miles a week in the Stinson Junior ambulance plane attached to the hospital. In this way he has been able to extend his activities throughout Oklahoma and considerable portions of the neighboring states. It is not uncommon for him to make a call, or to transport patients, as much as 500 miles away from Mangum. In sparsely settled country where bad roads, washed-out bridges and the like prevail, patients may be called for and moved to the hospital in less time than the average country doctor could reach them by automoblie or on horseback.

Canadian fisheries patrol

THE poaching of salmon in preserve areas, or by U. S. fishermen within 3 miles of the Canadian shore line (a practice frowned upon by an international treaty of 1818) is occasionally encountered along Canada's Pacific seaboard. The constant supervision of some 10,000 Canadian fishing boats, as well as many hundreds operated under American registry along 7,000 miles of irregular coastline would be an impossible task without the help of airplanes. Fisheries patrol bases are maintained at eight strategic locations in British Columbia waters. Boeing flying boats operating out of these stations have averaged about 450 hours a year on fish-patrol work during the last three years.

Tea over London

IMPERIAL AIRWAYS is capitalizing on the average Briton's love for his afternoon tea by offering daily tea flights from Croydon on Sunday afternoons during the summer season. For about $5 (at the present rate of exchange) a tea-flighter obtains automobile transportation to and from Croydon, a 30-minute flight in one of Imperial Airways 40-passenger ships of the Heracles class, and his regular afternoon tea. Many people taken into the air for the first time under such pleasant and novel circumstances later find reason to become regular passengers on Imperial Airways Continental and Empire services.

Agricultural investigation above the clouds

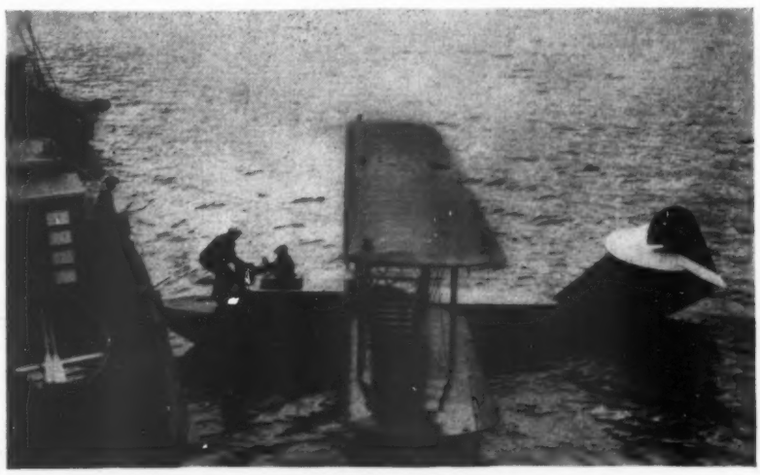
HIGH-ALTITUDE research usually connotes investigation of wind and weather. Recently, however, the experts of the United States Department of Agriculture have been combing the upper reaches of the atmosphere in an effort to determine the mechanism of distribution of certain plant diseases. Spores, or seeds of fungoid diseases of types which attack various vegetables and fruits are known to be carried by winds at high altitudes. By exposing nutrient-coated sterilized glass plates to the air during airplane or airship flights specimens for laboratory investigation may be collected. Cultures thus obtained may readily be isolated and identified.

F. C. Meier of the Department of Agriculture has conducted investigations along the Eastern seaboard, making two flights on the airship Los Angeles and several in Coast Guard airplanes. Similar research on the spread of wheat stem rust in the Middle West is being conducted by Dr. E. C. Stakman, plant pathologist of the University of Minnesota, in Naval Reserve training airplanes stationed in the Great Lakes district.

Girotaxi service in Florida

FOR many reasons, short-haul services have never appealed to operators of conventional aircraft. The autogiro, however, with its almost uncanny ability to get into and out of restricted landing areas opens up new possibilities for the aerial taxi-man. It has frequently been suggested that therein lies one practical solution to the problem of transportation of airline passengers from landing fields to civic centers. Except for a few isolated cases, however, such as the picking up of Giro-inventor Cierva from a New York pier, or of Senator Bingham from the steps of the Capitol (both stunts with obvious news value), no regular service of this type has heretofore been put into operation.

Certain Florida vacationists, guests of the Miami-Biltmore and its allied Florida Year-Round Clubs, have recently had the use of what is probably the first regular girotaxi service in the United States. A Pitcairn cabin giro powered with a Wright Whirlwind engine (AVIATION, November, 1932, page 457) is now being operated on frequent schedules between the hotel and the Sun Club and Country Club. Automobiles require forty minutes for the trip—the giro, eight minutes.

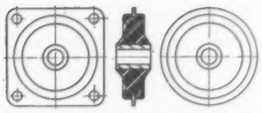


Crew of patrol boat "Pintail" about to board a fishing boat to inspect the cargo for illegal catches.

THE BUYERS' LOG BOOK

Vibration insulation

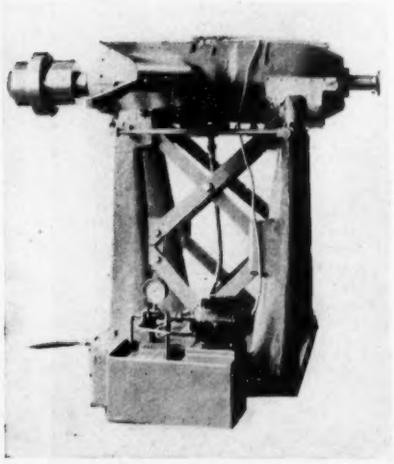
THE elimination of direct vibration from engines and propellers is one of the most important considerations in the design of modern transport airplanes. Vibration is not only unpleasant for passengers, but frequently accounts for damage and consequent loss of reliability of navigation instruments. The control of vibration in aircraft follows the same general principles laid down for other industrial processes, and the Lord Manufacturing Company of Erie, Pa., has recently applied successfully an existing type of bonded rubber mounting to airplane instrument boards and other parts. Plate-form mountings, either round or square, as shown in the accompanying illustration, may be used to fasten instrument panels to members of the primary structure. The rubber disc diameters vary from 1 to 2 in., and the center hole from a No. 19 drill to $\frac{3}{4}$ in. The metal parts of the standard units are cold-rolled steel. Special mountings of monel, aluminum, or chromium-plated steel may also be furnished.—AVIATION, *March, 1933.*



Lord insulating mountings may be obtained in either round or square form.

Airport signal gun

MANY airports where traffic is heavy have adopted the light-beam signal system of dispatching airplanes, first developed at London's busy Croyden. Dispatching "guns" have appeared in many forms, varying with the ingenuity of local personnel and the materials found at hand. Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has recently made announcement of a standardized signaling gun now available commercially. The unit consists of a barrel, 8½ in. in diameter and 16 in. long, fitted with two pistol-grip handles and carefully balanced to reduce fatigue. It shoots a very narrow beam of light, red or green at the option of the dispatcher. A sighting tube permits accurate aiming at any desired airplane, and the extremely narrow beam insures that the ship on which it is aimed is the only one from which the signal may be seen. In the daytime the beam is said to be visible at 10 miles, at night 15 miles.—AVIATION, *March, 1933.*



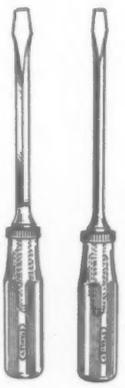
Farrel-Birmingham transmission dynamometer.

G.E. bi-post lamp

INCANDESCENT lamps of a radically new type of construction have recently been made available for aeronautic use by the General Electric Company of Schenectady, N. Y. The new lamp differs from the conventional in two particulars. In the first place the new style bases consist simply of two heavy copper prongs, projecting through a glass cup and secondly, the filament unit is firmly supported on two heavy vertical nickel channels held together by horizontal bars of insulating material, a mounting that insures against shifting of focus. By the selection of metals and glass having the same rates of thermal expansion the connecting prongs are cast directly into the glass base, thus eliminating the more or less costly and complicated lead-in arrangement used in high-powered lamps of earlier design. These lamps are available in 500-watt sizes for airport floodlighting, and have recently been approved by the Airways division of the Aeronautics Branch of the Department of Commerce for the 1,000-watt rotating beacon service.—AVIATION, *March, 1933.*

Dynamometer

A TRANSMISSION TYPE dynamometer intended for testing airplane engines and propellers up to 1,000 hp. has been developed by the Farrel-Birmingham Company, Inc., of Buffalo, N. Y. The overall diameter of the dynamometer has been made as small as possible (17 in. was the working limit set) to eliminate any interference of engine cooling by the propeller slipstream. The operation is based on the reaction of bearings to the tooth-pressure of gears. The apparatus consists essentially of a housing containing two pairs of gears, each pair consisting of an externally-toothed pinion, engaging an internally-toothed gear, so arranged that the driving and driven shafts are in alignment, and the intermediate gear shaft offset from the main axis. The torque reaction between the main and auxiliary shaft is measured by a torque arm. The machine is also designed to measure the thrust reaction of the propeller. Although designed primarily for aircraft power plant use, the dynamometer may be applied to a number of other industrial power transmission measurement requirements.—AVIATION, *March, 1933.*



Screw drivers

HOT-FORGED tips and shanks set in unbreakable shockproof handles feature a new line of screw drivers by the Stanley Rule & Level Plant of New Britain, Conn. Bolsters are forged integral with the blades to prevent driving the blade up into the handle under heavy pounding. The handles are of a shatter-proof amber-colored composition of high dielectric strength, which is unaffected by moisture or oil. Five sizes are available. —AVIATION, *March, 1933.*

Stanavo engine data book

GENERAL discussion of the properties of aviation gasolines and oils, together with specific recommendation for the use of Stanavo products with various aircraft engines are contained in a little booklet distributed by the Stanavo Specifications Board, Inc. Copies are available upon request through any Standard Oil distributor. —AVIATION, *March, 1933.*